VERT Workbook

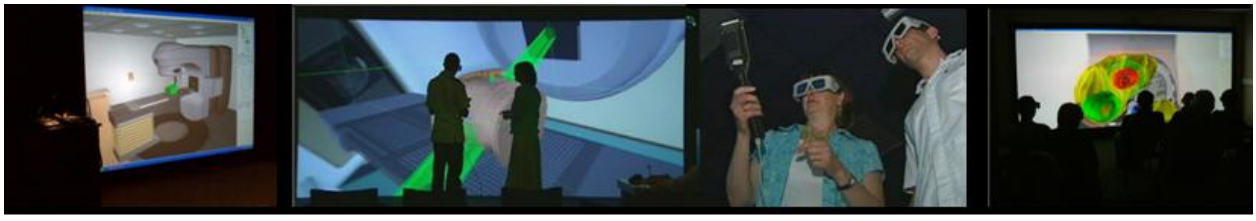


Table of Contents

SECTION 1

Chapter 1 Interface overview 6

The Main Menu (top left menu) 6

The Plan Browser (top right section) 7

The Control Panel (bottom right section) 8

Adjusting the View 9

Menu navigation 9

Changing treatment machines 9

Chapter 2 Loading a patient 11

Loading a patient into VERT 12

Plan type 13

Immobilisation devices 16

Patient position 16

Chapter 3 Manipulating structures 19

Default view 19

Visualisation of CT slices 21

Chapter 4 Beam display 26

Single beam display 26

Beam Types 28

Display multiple beams 29

Beam Eye View display 31

Deliver an IMRT or VMAT beam 35

Chapter 5 Dose display 37

Chapter 6 Viewing ICRU dose levels using VERT 44

Chapter 7 Simulated Errors 46

Chapter 8 Virtual Presenter 50

Use of the virtual presenter 50

Introduction 50

Inserting pictures 53

Saving the slideshow 57

Creating a new slideshow 58
Using automatic timings to run through the virtual presenter slides 60
Creating a slideshow file 62
Deleting a Virtual Presenter file. 65
Chapter 9 Radiation therapy concept visualisation using VERT 67
Isocentre visualisation using axis feature 67
Demonstrating isocentre location within the patient 72
Demonstrating the Anti-collision option within VERT 74
Chapter 10 Demonstrating patient separation using VERT and a block 76
Procedure 76
Chapter 11 Making shifts from an origin marker 80
Method 1 (plan contains markers) 80
Couch controls 86
Method 2 (plan does not contain markers) 87
Chapter 12 IGRT workflow 92
IGRT Workflow 92
Chapter 13 Using keyboard shortcuts 98
SECTION 2
Chapter 14 Example sessions to use with students 100
Linear accelerator – Machine geometry Session 100
Facilitator Notes 100
Introduction 100
Revision 100
Demonstration – facilitator led 100
Student Exercises 101
Demonstration – facilitator led: Single fields / Parallel pair techniques 101
Demonstration – facilitator led: Terminology 102
Student Exercise 102
Summarise session 102
Chapter 15 Linear accelerator – initial visualisation session 103
Facilitator Notes 103

Introduction and initial scoping 103
Demonstration – facilitator led 103
Linear Accelerator Room 103
Summarise session 105
Chapter 16 Technique – Prostate 106
Facilitator Notes 106
Introduction and initial scoping 106
Revision - anatomy 106
Discussion – pre-treatment 106
Demonstration – facilitator led 107
Student Exercise 107
Demonstration – facilitator led 107
Student Exercise – plan critique 108
Discussion – post-treatment 108
Summarise session 108
SECTION 3
Example 1 109
Facilitator Notes 109
Introduction 109
Revision 109
Demonstration – facilitator led 109
Student Exercises 109
Demonstration – further demonstration – next concept to be explained 109
Demonstration – facilitator led: Next concept 110
Student Exercise 110
Summarise session 110
Example 2 111
Lesson plan for using VERT 111

Purpose

This workbook will be used during VERT training and can also be used to refresh VERT knowledge post training.

Each session is designed for use with the demonstration patients provided by Vertual. Similar patients can be substituted if required.

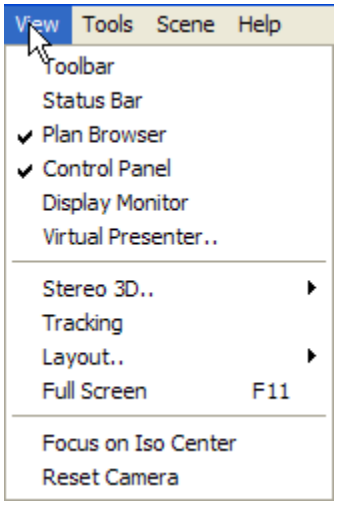
This workbook is designed to improve knowledge of the VERT system in practice and complements the VERT user manual.

Chapter 1 Interface overview

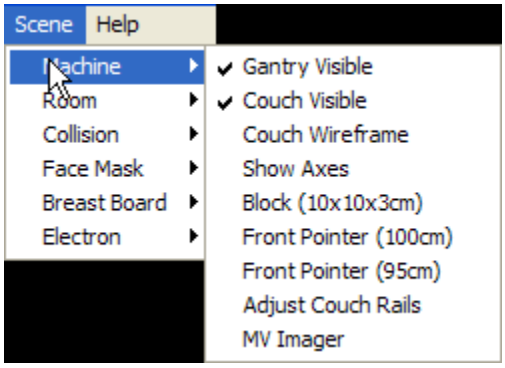
The interface of VERT has been designed to be simple to use, intuitive and user friendly.

The Main Menu (top left menu)

This contains options to change the viewing and display of the main VERT window. Also the top left hand section is used to load patients and set preferences for the system.



The **View** menu as selected from top left area of the screen.

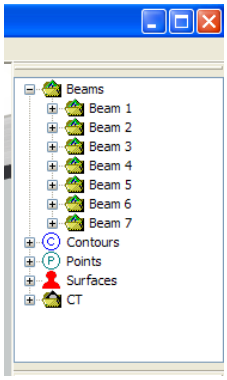


The **Scene** menu as selected from top left area of the screen.

The Plan Browser (top right section)

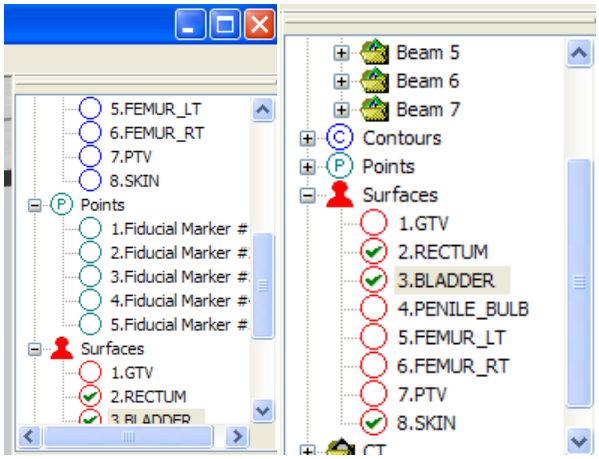
The section to the top right of the main VERT screen contains information from the DICOM files of the loaded patient. Prior to a patient being loaded this section will be blank. Once a patient is loaded the beams, contours, reference, points, structures and CT slices will appear.

The empty **Plan Browser** in the top right prior to patient loading.



The **Plan Browser** in the top right once a patient is loaded.

This section is used to change the displayed objects from the treatment plan, where a circle or square appears in VERT this is a toggle on/toggle off box. Using a right click of the mouse when hovering over a structure will give further options for beams, contours, structures and points.

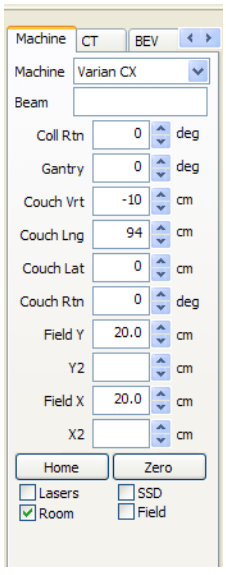


Examples of the toggle on / toggle off tick options (also known as check-boxes).

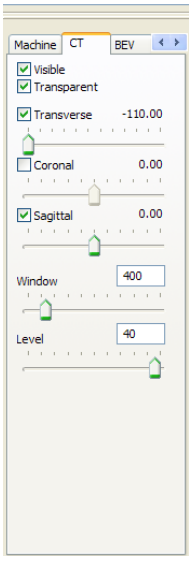
The Control Panel (bottom right section)

The bottom right hand side of the VERT screen is where the controls are located to view aspects of the plan and to change viewed parameters of the machine, beams eye view (including DRR), dose and set up error. The patient can also be positioned using the patient position tab.

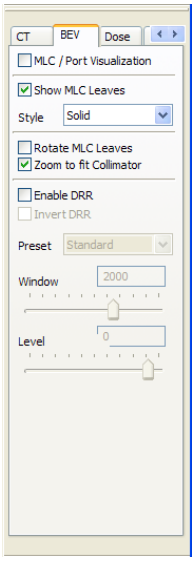
The controls are divided into several pages and each tab contains display options related to the tab name.



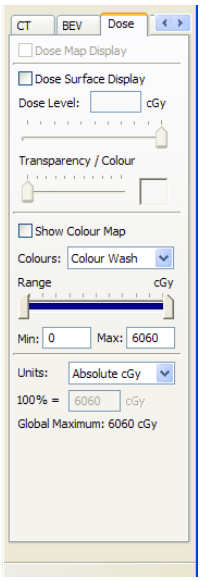
Machine tab



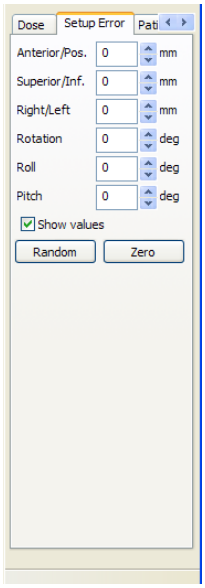
CT tab



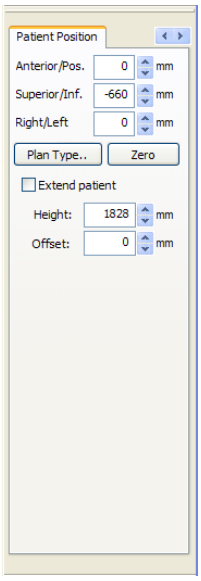
Beams eye view tab



Dose tab



Setup error



Patient position tab

Adjusting the View

The mouse must be in the main VERT display area to adjust the view.

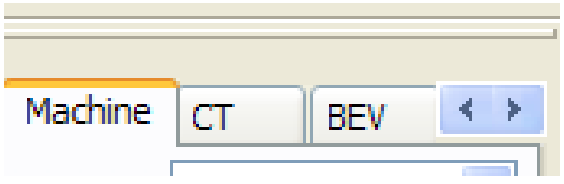
To rotate the view; hold down the left mouse button and move the mouse to the right to rotate to the right and to the left to rotate the view to the left.

To pan the view within the window hold down the mouse wheel and move the mouse until the view is changed as needed

To zoom the main view hold down the right mouse and push the mouse away from you to zoom in/ navigate in to the view and towards you to pull the view away and zoom out.

Menu navigation

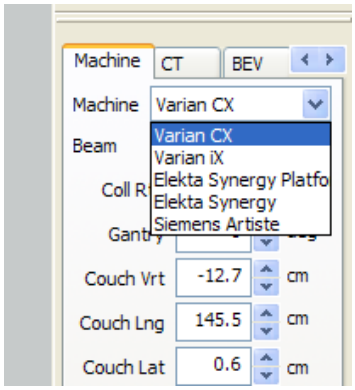
The bottom right hand side of the user interface contains the menu tabs. To navigate through the tabs and reveal the options available use the small arrows to the right of the tabs.



Use the small arrows to select menu tabs.

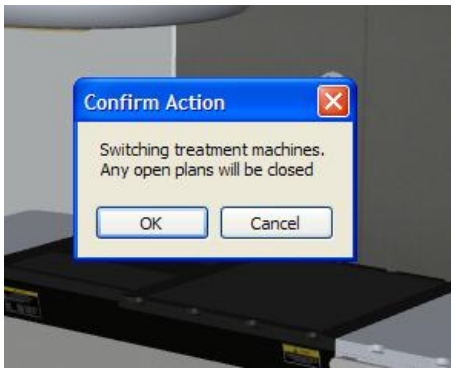
Changing treatment machines

To change treatment machine use the drop down menu in the machine tab. Once the machine is changed the patient will be cleared and needs to be reloaded.



To choose a different Linac.

Note: Your PC will display only machines included in your license so fewer options may appear than in the illustration above.



The patient must be reloaded if the Linac is changed.

Chapter 2 Loading a patient

Patient required: a patient from your own planning system.

Alternatively: the patient could be a demonstration patient from the Vertual CDROM.

Time: 15 minutes

This session will cover the following:

- Data required
- Anonymisation
- Loading a patient into VERT
- Plan type
- Patient position

Remember

VERT has no database.

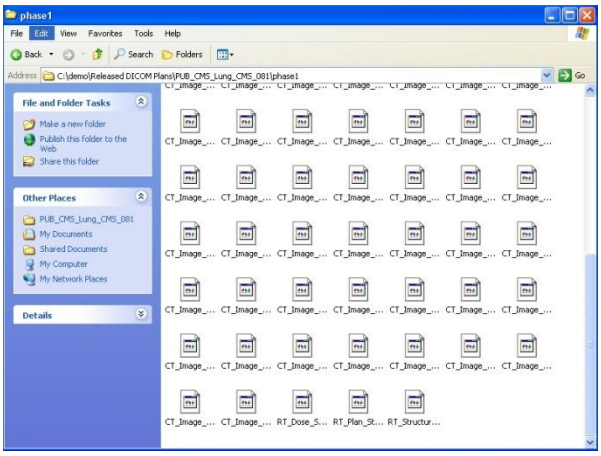
Plans cannot be altered in VERT – only viewed.

Transfer using a USB stick.

Messages when opening a patient – indicate progress / give clues if something goes wrong.

Data required

- To load a patient into VERT the CT images, structure set, dose and plan should be exported from the treatment planning system. This transfer can be completed using a USB stick or network shared drive.



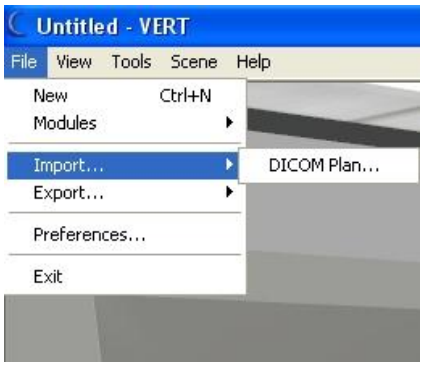
Anonymisation

- During export the patient data should be anonymised. Vertual recommends that all data used for training should be fully anonymised prior to use.

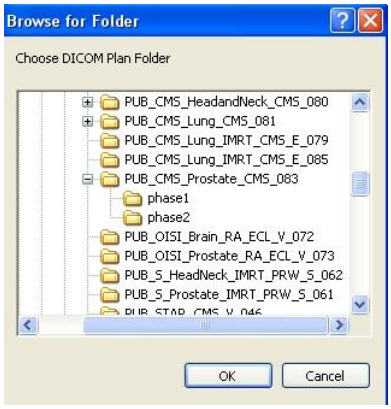
- For assistance with the process please email : support@vertual.co.uk

Loading a patient into VERT

To load a patient into VERT select the file import option

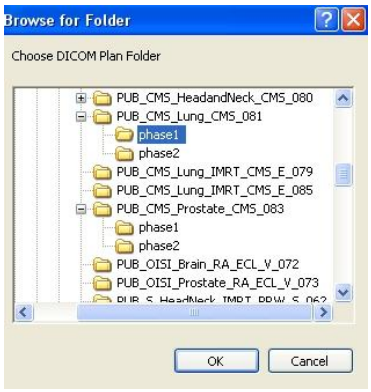


- A window will open allowing navigation to the correct directory where VERT plans are stored. If all VERT patients are stored in one location this default directory will always be correct making it easier to find the required plan.

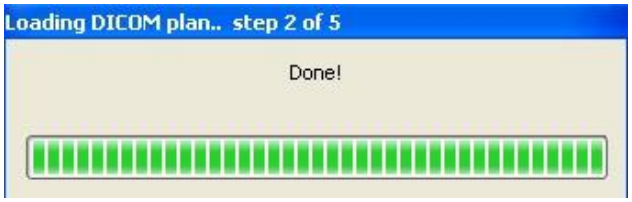


- Make sure the directory contains only the elements needed and that phase 1 and phase 2 are not one directory level lower. This will result in the following error messages in VERT.

If this happens, reselect file import and locate the correct directory (the directory containing the plan files) and the plan will load as normal.

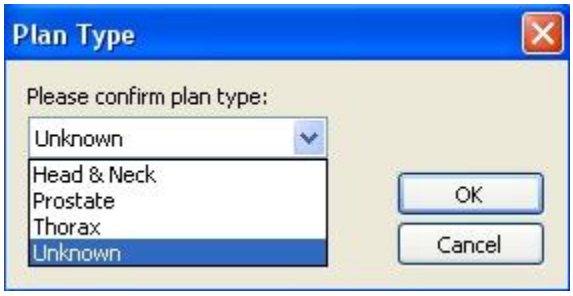


- Select the required patient and hit OK

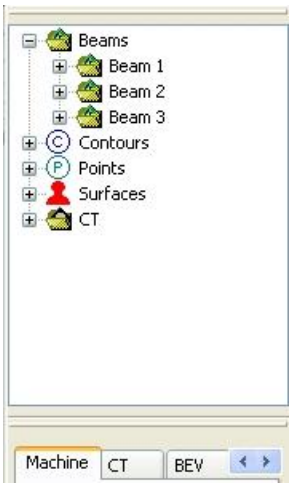


Plan type

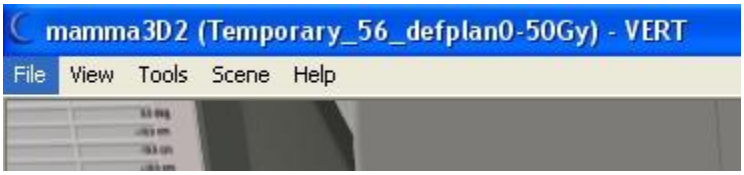
The first time a patient is loaded into VERT the plan type will be requested.



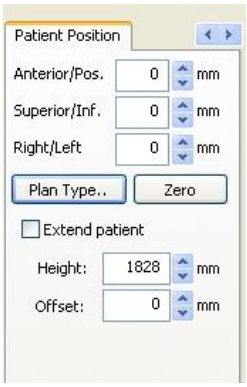
This places the patient in a reasonable location for the plan type. Select one of the options. The patient plan will be loaded into the plan browser on the top right hand side of the VERT screen.



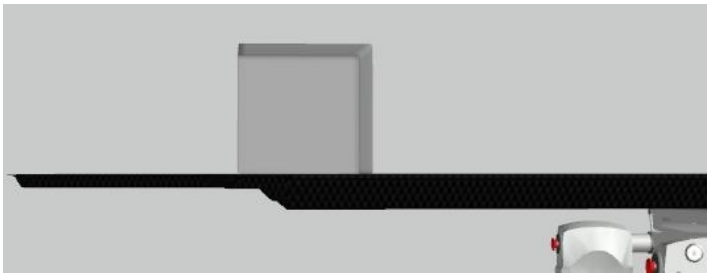
- Ensure the patient information does not appear in the top left hand side of the VERT screen. Some Anonymisation programs do not remove data from this tag in the RT plan file.



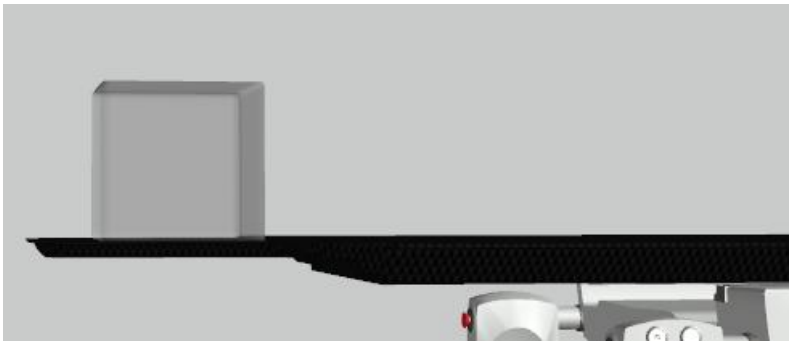
- Plan type
  Select the plan type option from the patient tab (lower left of the VERT screen)



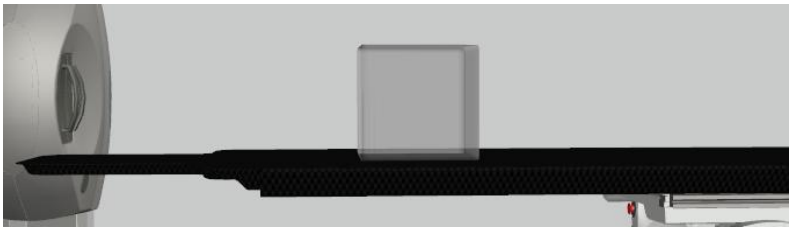
- The same window will open as during the plan load process.
- Change the plan type and see where the patient is positioned on the couch. Examples are below



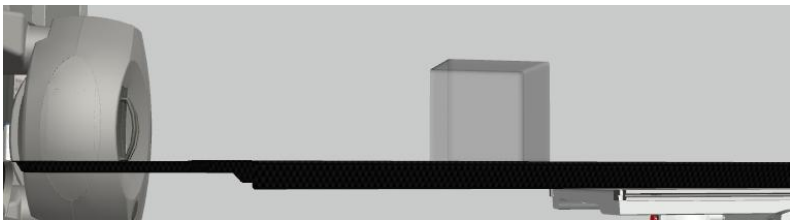
- Plan type - unknown.



- Plan type - head/neck



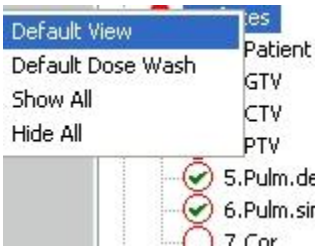
- Plan type - thorax.



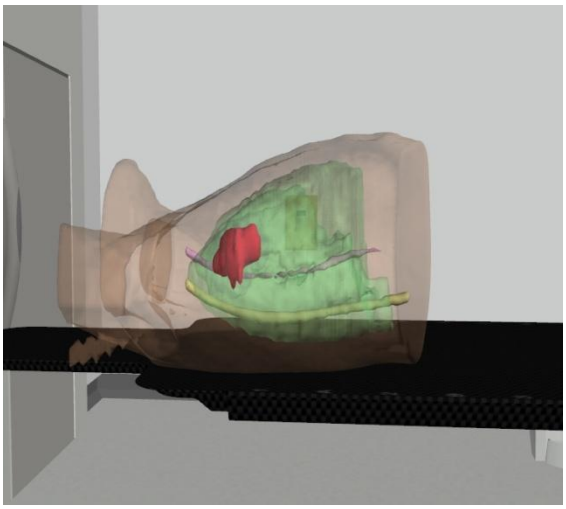
- Plan type - prostate.

Selecting a plan type is needed the first time a patient is loaded into VERT, when subsequently loading a patient the position will be based on the plan type chosen and where applicable any shift in patient position will be remembered.
The plan type can be changed by the user at any time using the option to select plan type in the patient position tab.

- The easiest way to turn on structures is to right click the structures option in the plan browser and select default view. Select this option.

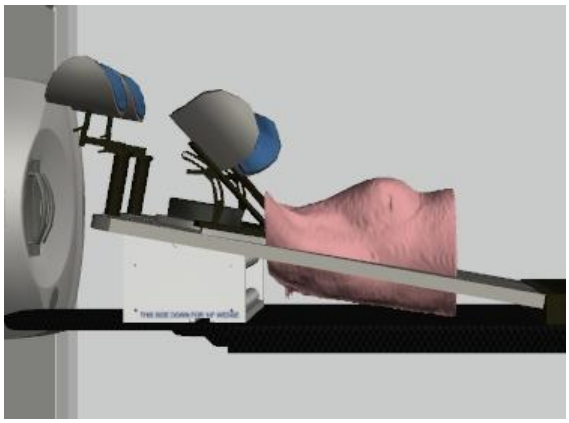


- All structures are switched on and the body is made transparent.



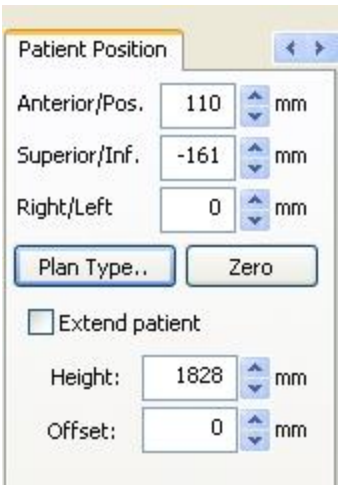
Immobilisation devices

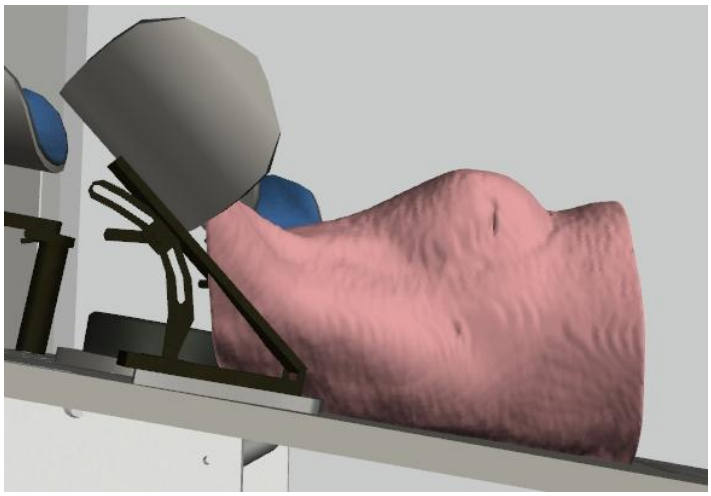
VERT has the option of a breast board and also a face mask. The process for moving the patient onto the immobilisation device is the same for both.



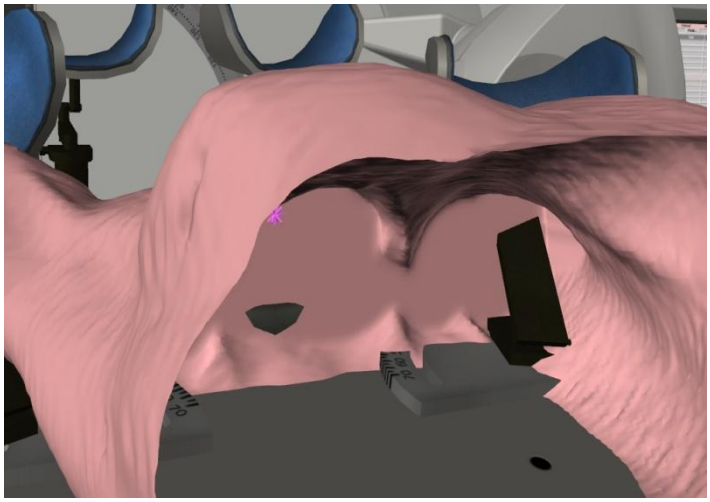
Patient position

When a patient is first loaded into VERT and the breast board turned on using the **Machine... Breast Board** option, it is likely the patient will not be in the correct potion on the couch. The position can be selected using the Anterior/Pos, Superior/Inf and Right/Left arrows as shown here.

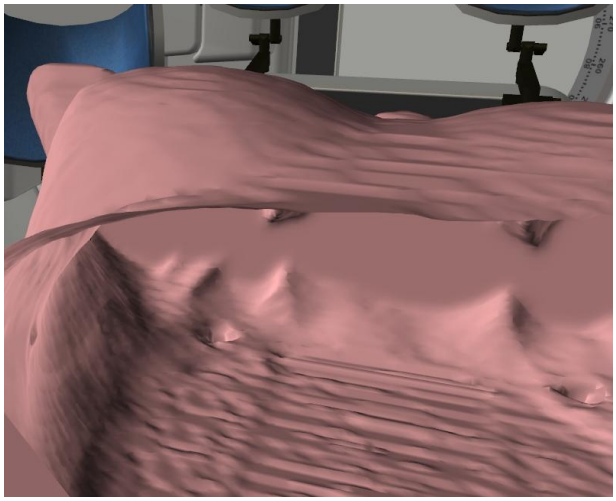




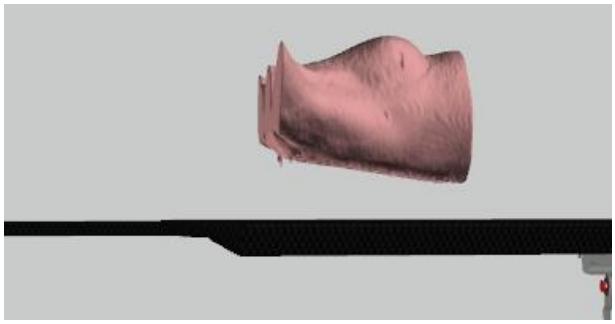
This needs to be done once only for the patient. When importing the patient again the position will be remembered.



When setting up the patient on the breast board zoom inside the patient outline and see if the patient is “in” the couch.



Use the Anterior/Posterior arrows to lower the couch as above.



Turn off the breast board and note that the patient remains in the position they were in when the breast board was present.

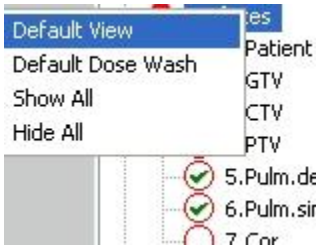
Remove the breast board before importing another patient.

Chapter 3 Manipulating structures

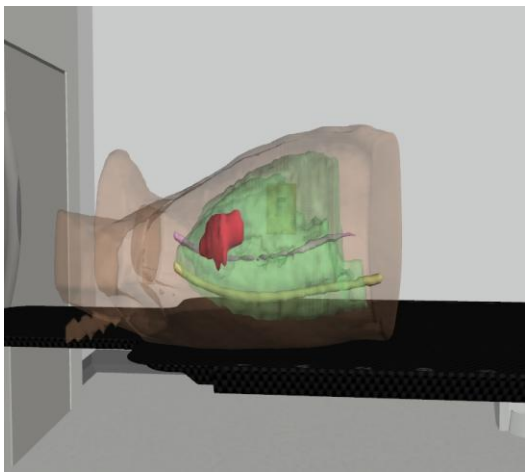
- Default view
- Structure visualization options
- Structure manipulation
- CT data visualisation

Default view

In the plan browser menu on the top right hand side of the VERT screen select the default view by right clicking on the word structures and selecting the default view option from the dropdown menu.

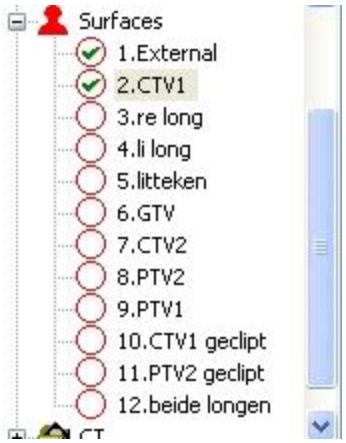


The result is that all structures will be turn on including the patient outline. The patient outline will be rendered transparent.



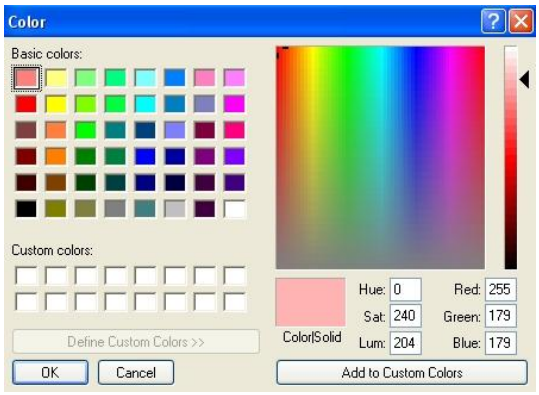
Right click on surfaces and select hide all from the drop down menu. This is the easiest way to have all structures invisible.

Structures can be toggled on and off individually by ticking the red circle using a left mouse click. Turn the patient outline on.

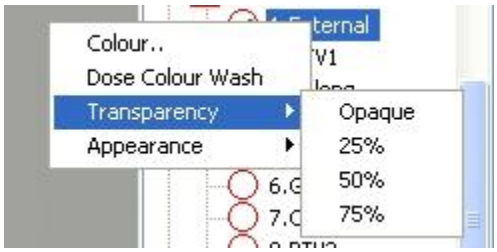


Change the colour of the patient outline using a right mouse click on the patient outline name and select the colour option.

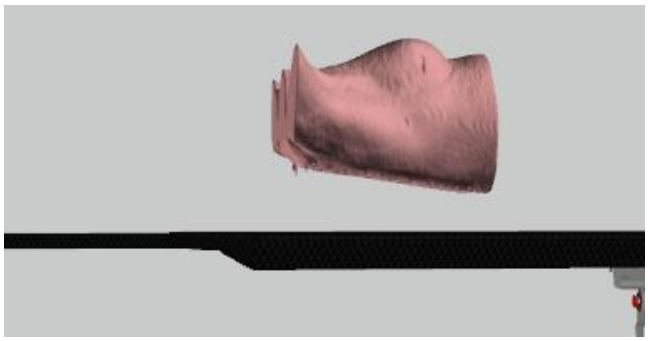
A window will open with colour options. Select the desired colour.



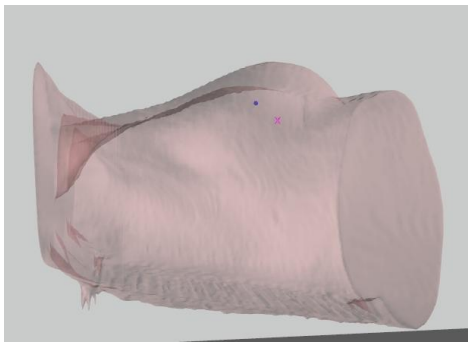
Change the transparency of the patient outline by right clicking the name external or patient outline and choosing the required transparency level.



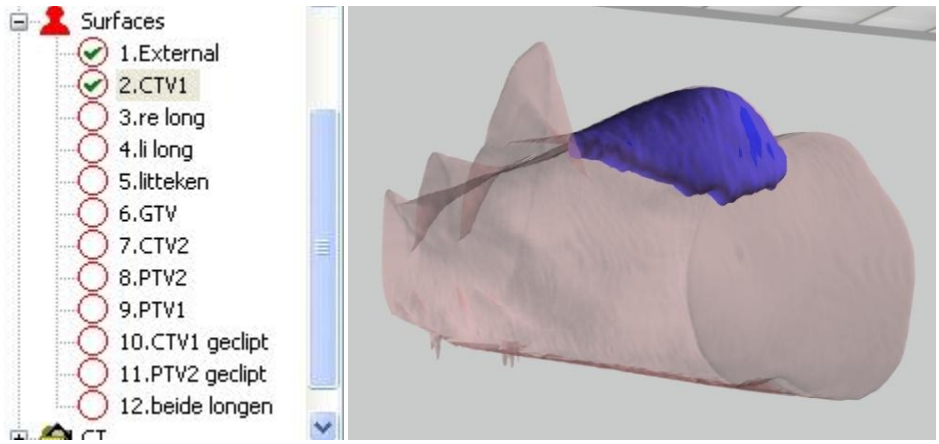
Change the transparency so the patient outline is opaque. The outline should look like the image below.



When choosing 75% transparent the body outline should look like the image below.



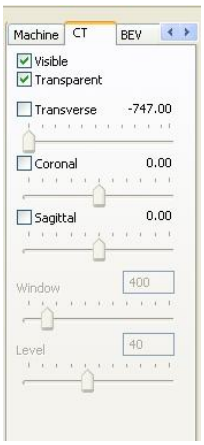
Turn on the CTV using the toggle box.



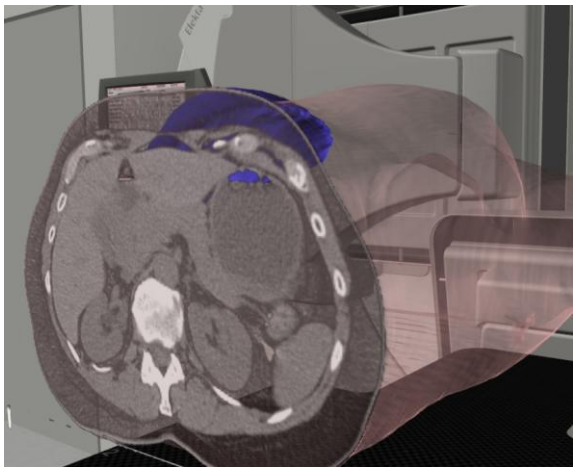
75% transparency gives good visualisation of internal structures.

Visualisation of CT slices

Select the CT tab from the lower right hand menu.



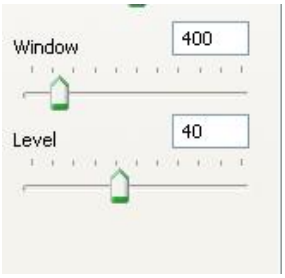
Click visible and turn on the transverse CT by using a left mouse click in the toggle box.



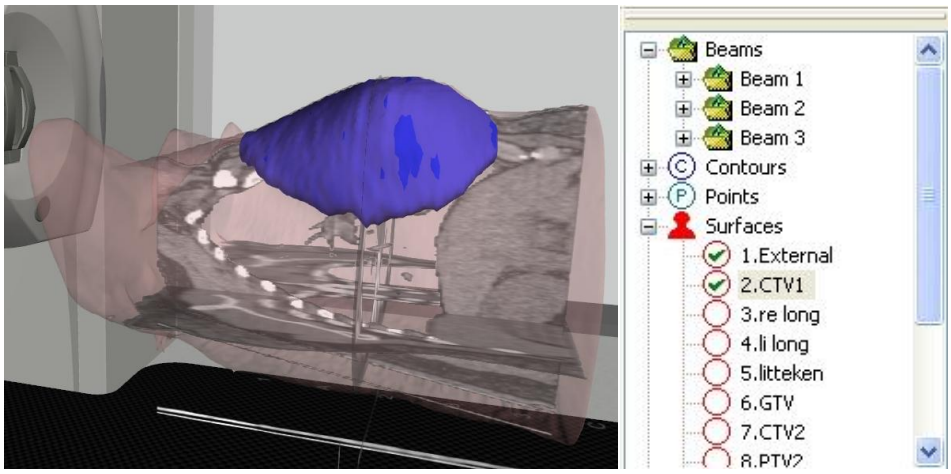
The CT planes are now visible.

Move the **Transverse slider** to navigate through the slices.

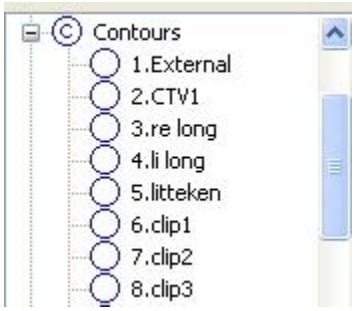
Use the **Window** and **Level** sliders to adjust the greyscale appearance of the CT slices.



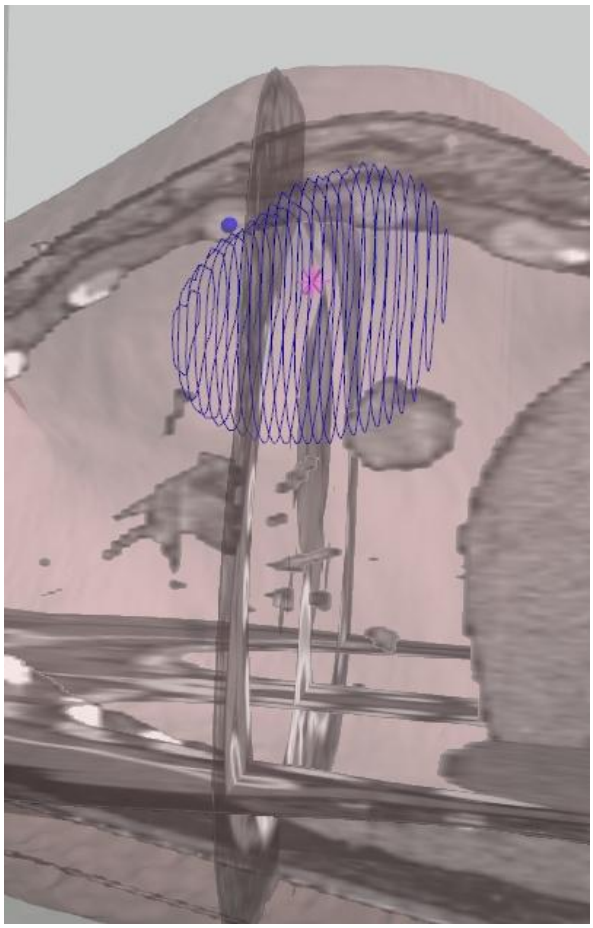
Click to turn on the **Sagittal** and **Coronal** CT planes. The sliders can be used to navigate through the other CT planes.



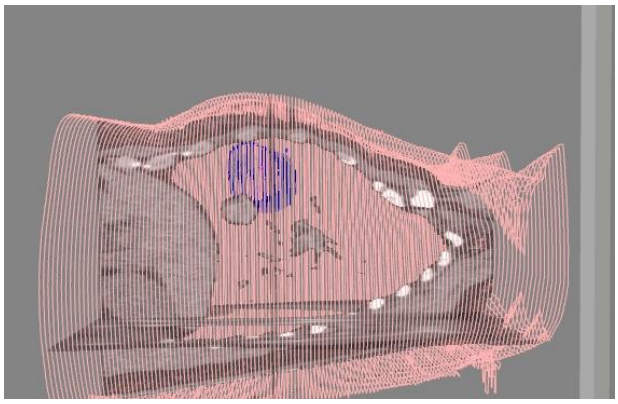
Explore the contours option to view how structures appear when using this option. The contours drawn on the CT slices will be visible. This can be useful when reviewing contouring and is an alternative to using the transparency option for a structure.



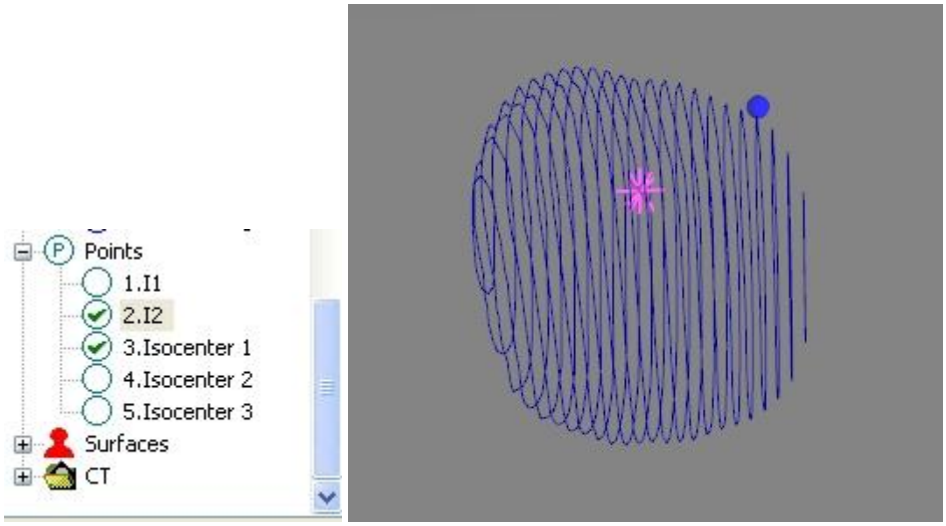
Structures are turned on in the same way as contours.



Turn on the patient outline as contours and rotate the view to see how the internal structures can be viewed when using this option.



Markers are easily visualised.



Chapter 4 Beam display

Patient required: any patient.

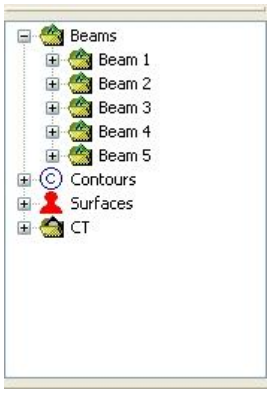
Time: 30 minutes.

This session will cover the following:

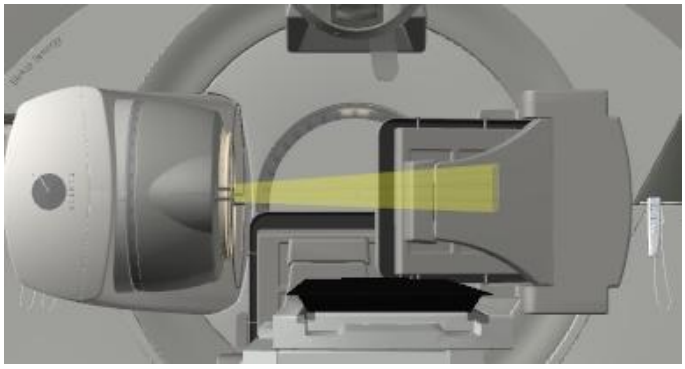
- Single beam display
- Full length/shortened
- Multiple beams display
- Active beam v etc
- Beam visualisation options
- BEV visualisation and dual view
- How to tell what type of beams are available
- Beam animation
- Viewing a single segment

Single beam display

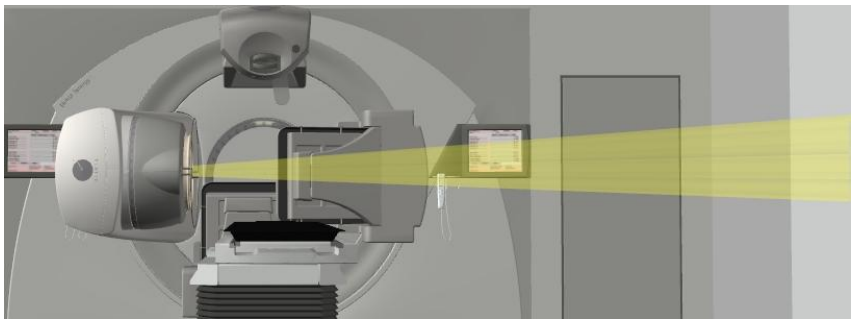
The number of beams for a plan will be shown in the plan browser on the top right hand side of the screen.



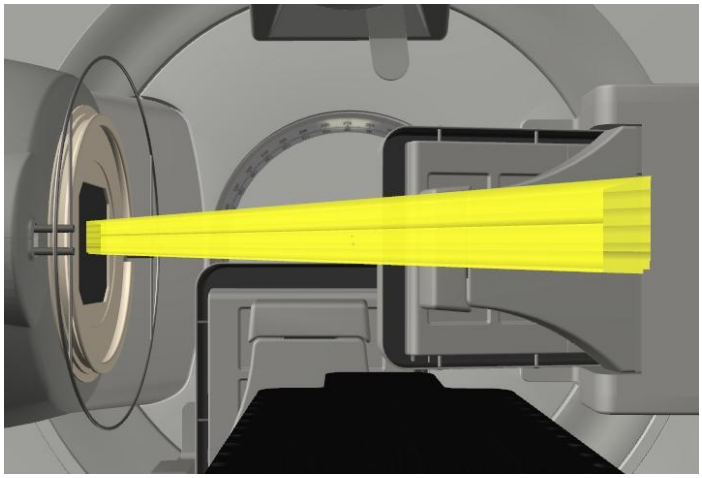
To view a beam click on the beam name.



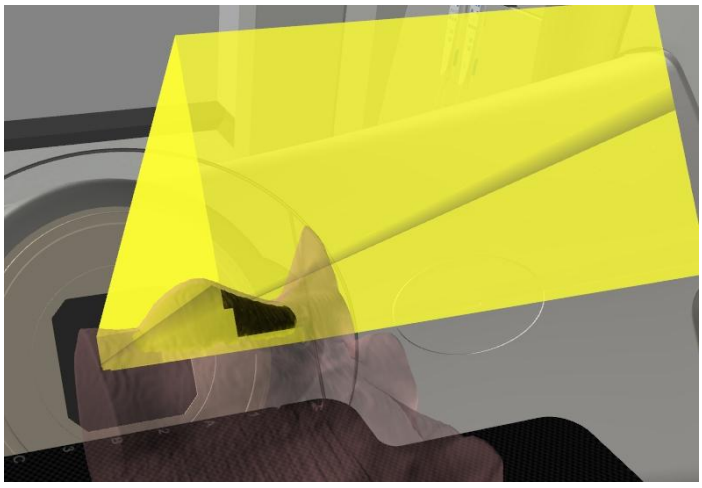
The beam will display transparent and shortened as above. Right click on the beam and select the full length option. The beam will be lengthened making it easy to show divergence.



Right click on the beam name and select transparency. Choose 20% transparent. The beam will appear as below.



This can be useful when viewing the coverage of beams and inclusion of structures and organs at risk.

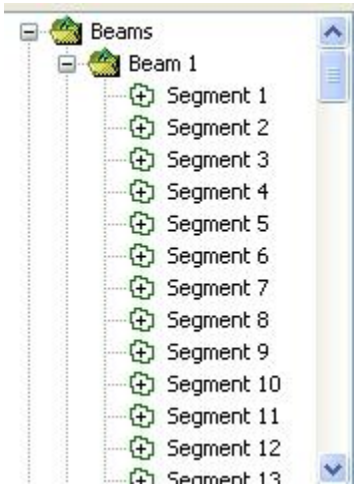


Click on the minus sign on the left of beams. This will collapse the menu so the number of beams is not visible. During student discussion where the number of beams is under discussion this option can be useful.

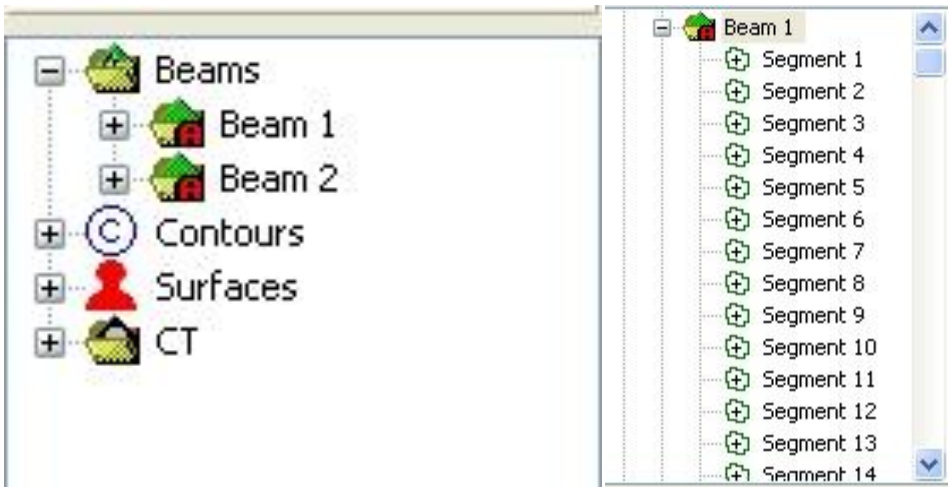
Beam Types

To view the type of beam in the plan click plus next to the beam name. The plan type can be determined from the resulting display.

Standard plan or conformal plan with 1 segment.



IMRT plan with multiple segments

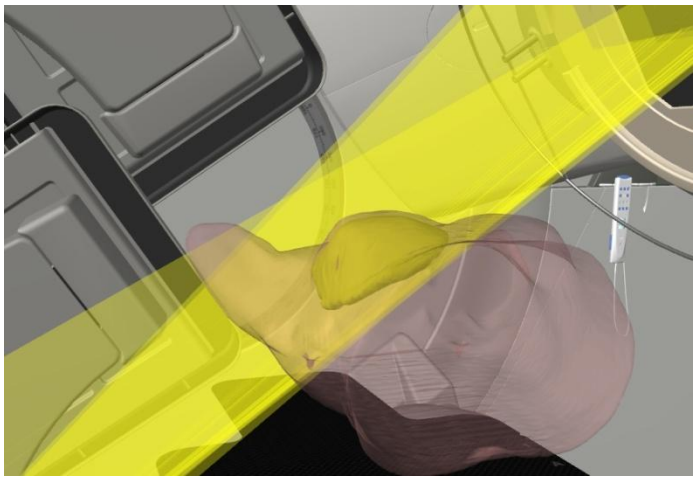


Arc beams (the A on the folder show this type of plan) this will be the display for RapidArc and VMAT plans.

Display multiple beams

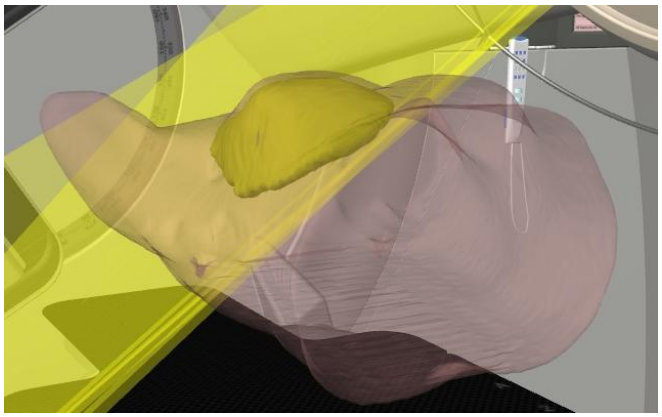
Click the beams option and right click for the menu to appear. Select **Show All**.

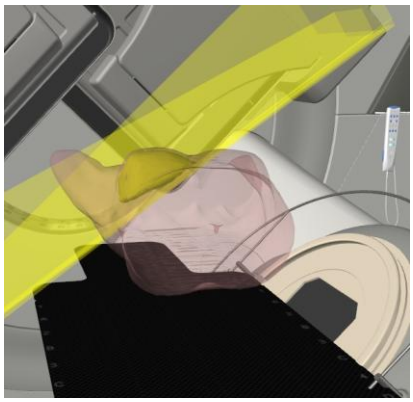
The beam names will show in bold and all will be visible.



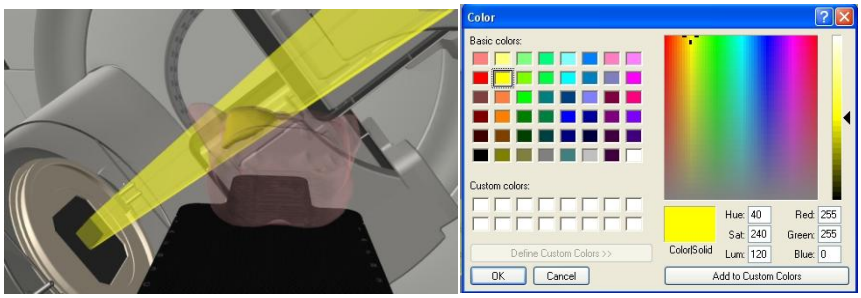
Individual beams can be switched off using a right click and the hide beam option.

The beam name is no longer bold.

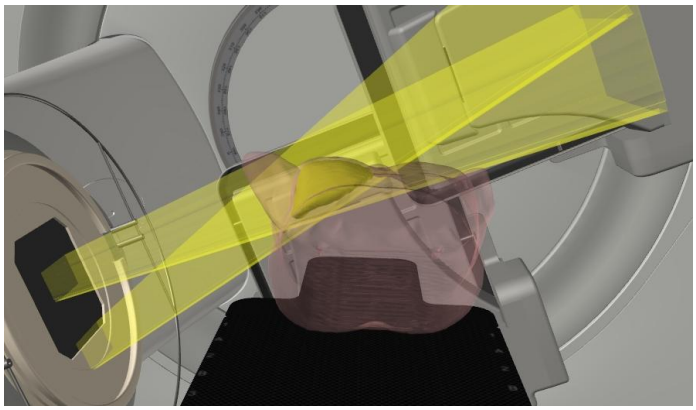




Now, only two beams are displayed. Rotate the gantry in the machine tab; the gantry will not be at the position of either beam. Select a beam to move the gantry back into the correct position for the selected beam.

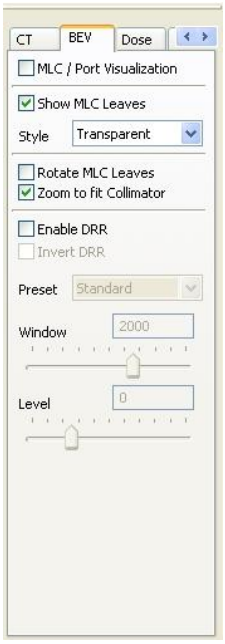


Change the colour of the beams; use the colour option from a right mouse click on the beam name. Beam colours can be selected individually so adjacent beams can be viewed differently.

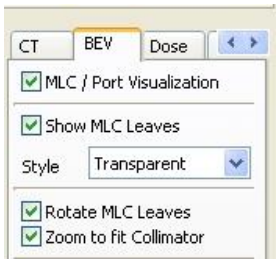


Change the beam display so that one beam is active and the name is bold. Rotate the gantry using the pendant and see how two beams now become visible. This is an active beam and a projected beam.

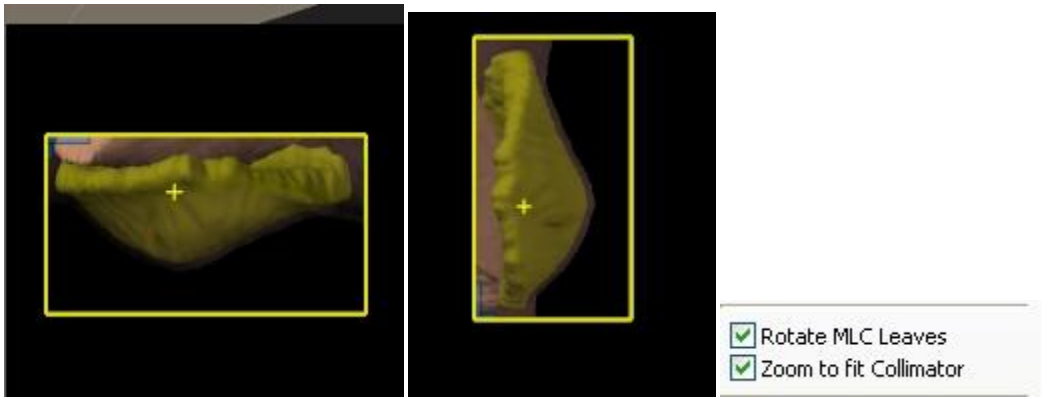
Beam Eye View display



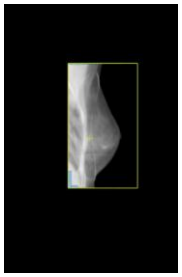
The Beam Eye View (BEV) menu is on the bottom right hand side of the screen.



Tick the MLC /Port visualisation option. A small beams eye view display will appear at the lower left hand corner of the main VERT window. Change the beams eye view by left clicking on a different beam name in the plan browser.

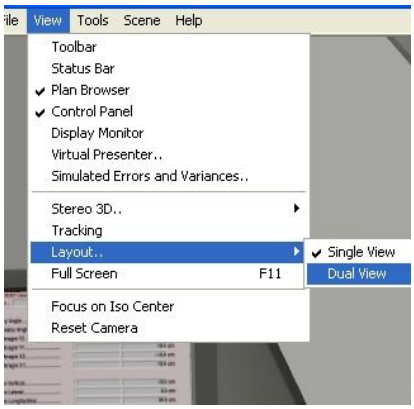


Change the orientation of the beams eye view window (the collimator will be angled and the patient straight) using the **Rotate MLC leaves** tick box.



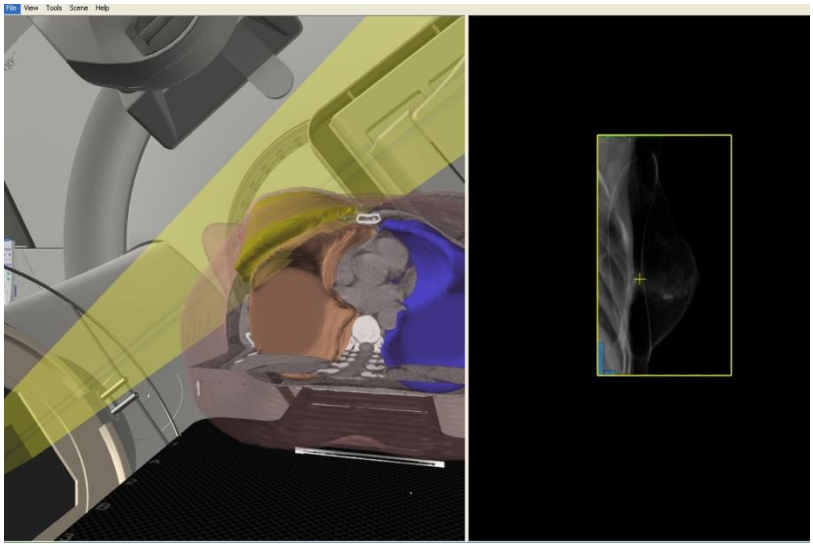
Tick the **Enable DRR** box to show the DRR image. Select a bone preset and change the window level and window width.

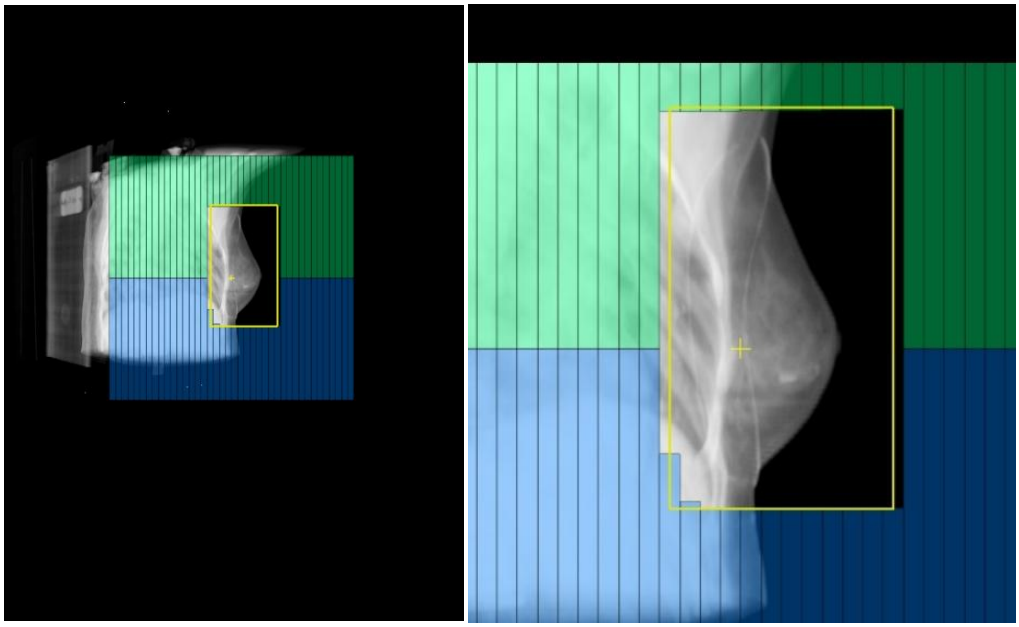
Split the main screen by choosing the dual view option from the view menu.



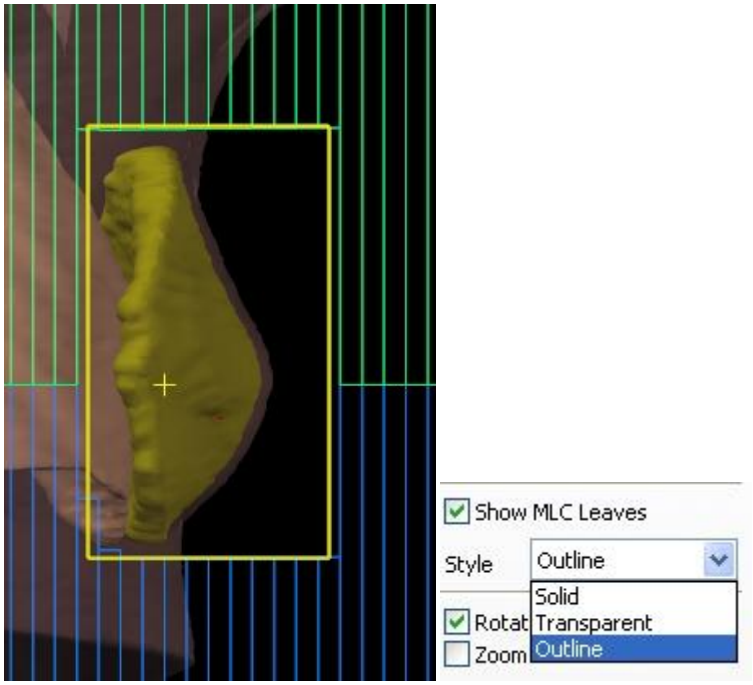
The DRR image will appear on the right side of the screen.

An in-field image is present by default. To view DRRs or structures outside the field borders untick the zoom to fit collimator option.

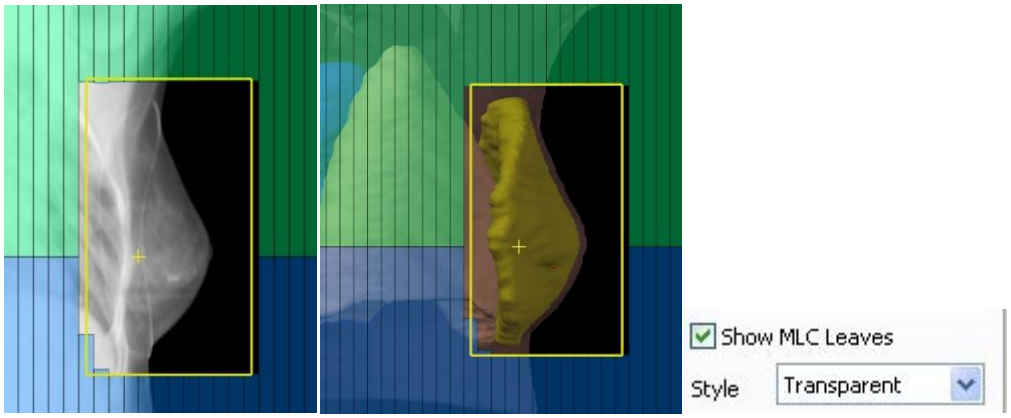




More information is now available. To zoom in hold down the right mouse button and push the mouse forward to zoom closer into the image.



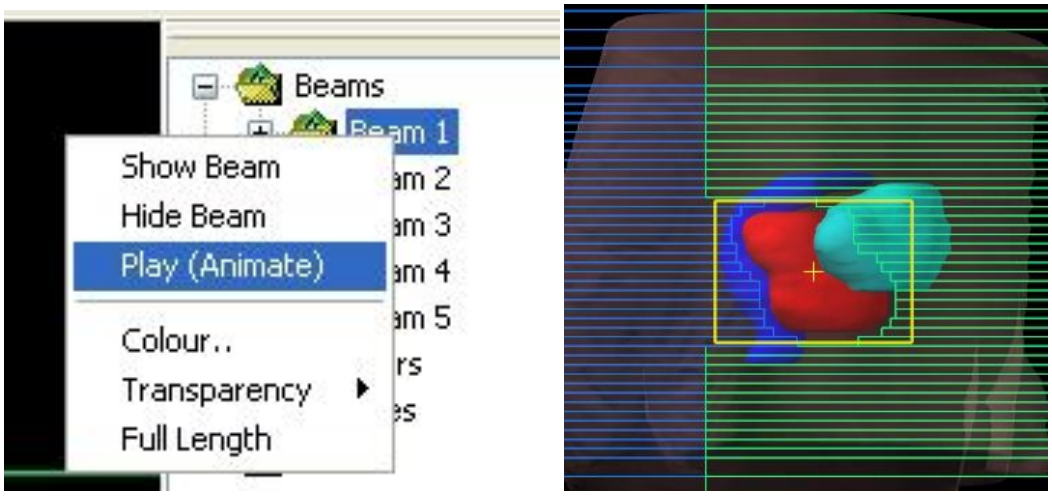
Change the appearance of the MLC leaves in the image by selecting a different option from the dropdown menu. The above image shows the MLC leaves visible as outlines.

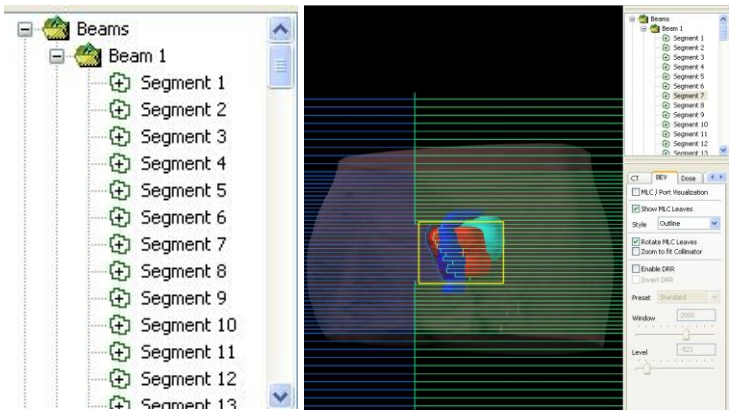


When choosing the transparent or solid MLC leaf visualisation option the image will look like the examples above.

Deliver an IMRT or VMAT beam

To animate the leaf motion during beam delivery, right click on the beam and select Play (animate). The sounds of the MLC leaves travelling can be heard.





Clicking on an individual segment will show the MLC leaf positions during the segment. Click on a segment under the beam name and view the MLC leaves.

Chapter 5 Dose display

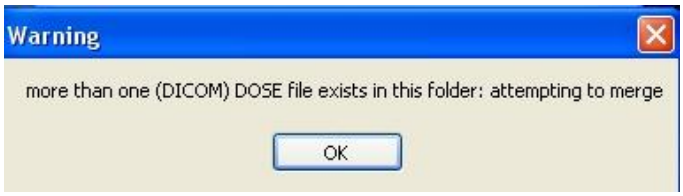
Patient required: any patient loaded onto VERT with dose information.

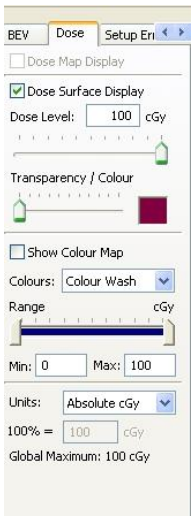
Time: 15 -30 minutes.

This session will cover the following:

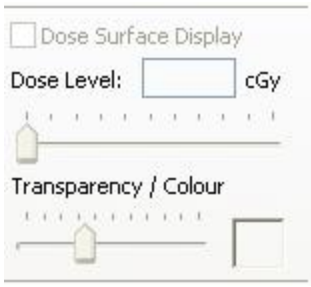
- Patient without dose information
- Dose Cloud display
- Changing transparency of dose cloud display
- Changing colour of dose cloud display
- Dose colourwash
- Dose colourwash and adding structures
- Dose colourwash options
- Dose colourwash slider
- Viewing dose distributions from the planning system
- Viewing/comparing plans

When importing a plan the following message sometimes appears. This can happen when the dose per beam has been exported from the treatment planning system. Also, if several dose grid files are present in the patient directory. VERT will sum the dose files.



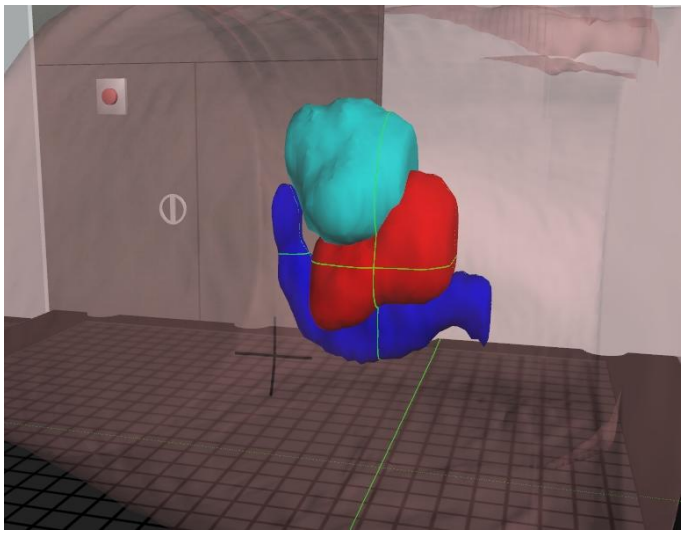


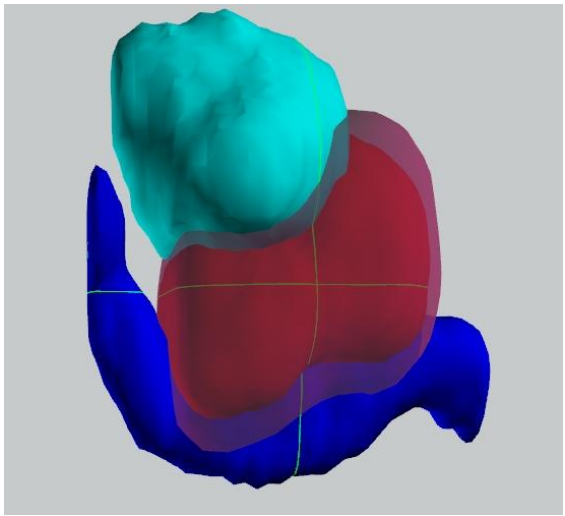
The dose tab is located at the bottom right hand side of the VERT interface.



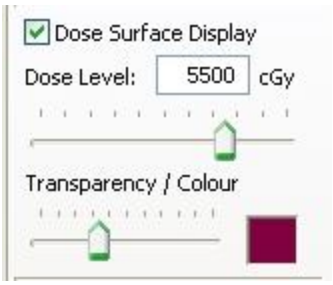
If a dose file is not present for a patient the dose surface display box will be greyed out.

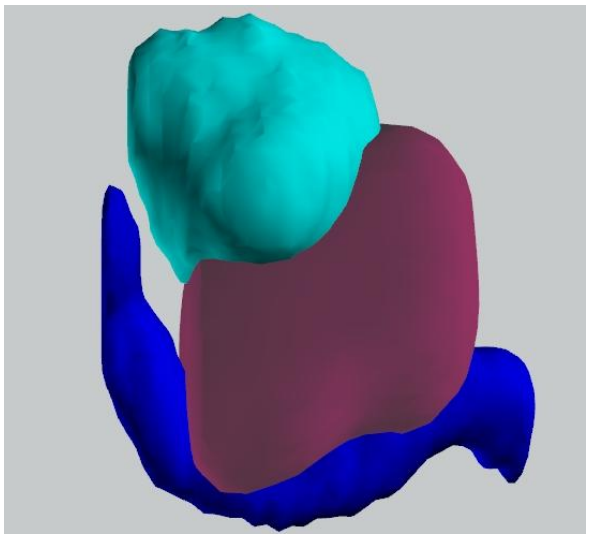
Choose a plan with dose, turn on the target volume and two organs at risk.



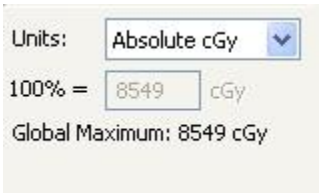


Tick the dose surface display box and use the slider bar to change the dose value. Move the slider underneath for Transparency to see the target volume inside the dose surface.

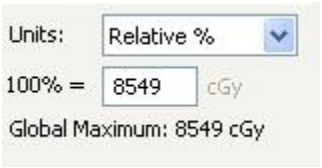


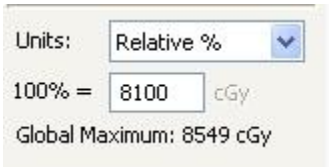


Move the transparency slider to the left most position the dose surface will be opaque.

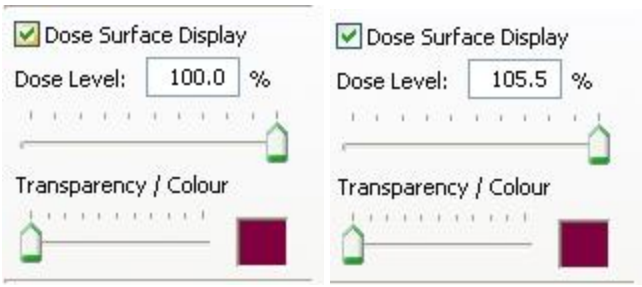


The default viewing option for dose is absolute dose in cGy. Look to the bottom of the dose menu. The option to enter the prescription dose is greyed out.

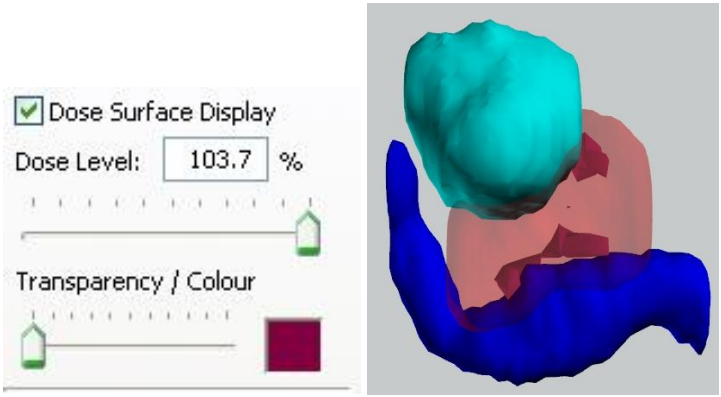




Change the Units to Relative % in the drop down menu. The 100% value can now be changed. Enter the prescription dose into this box.

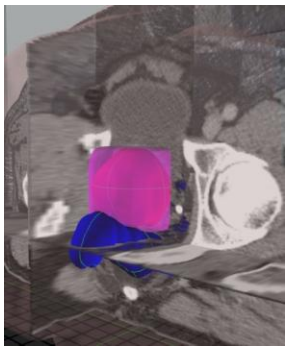


This changes the maximum dose value visible to the percentage global maximum of the plan.

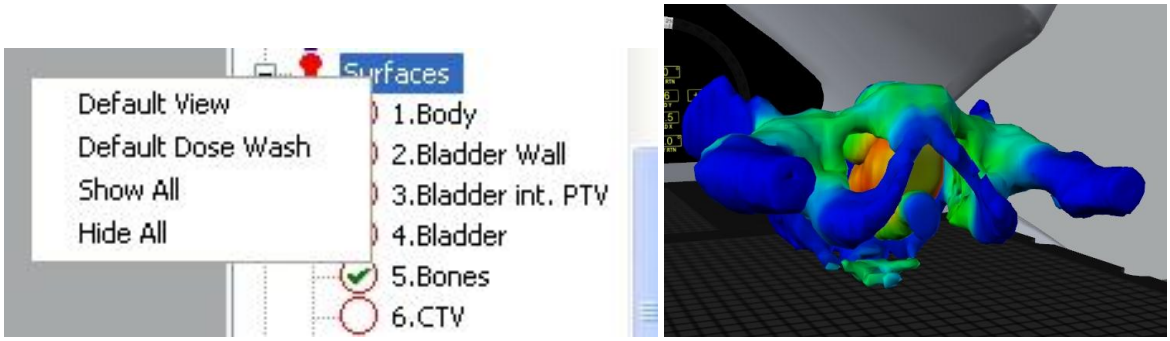


Make the target volume transparent and view doses over 100% within the target volume.

Turn on the dose surface display and view CT images for the patient.

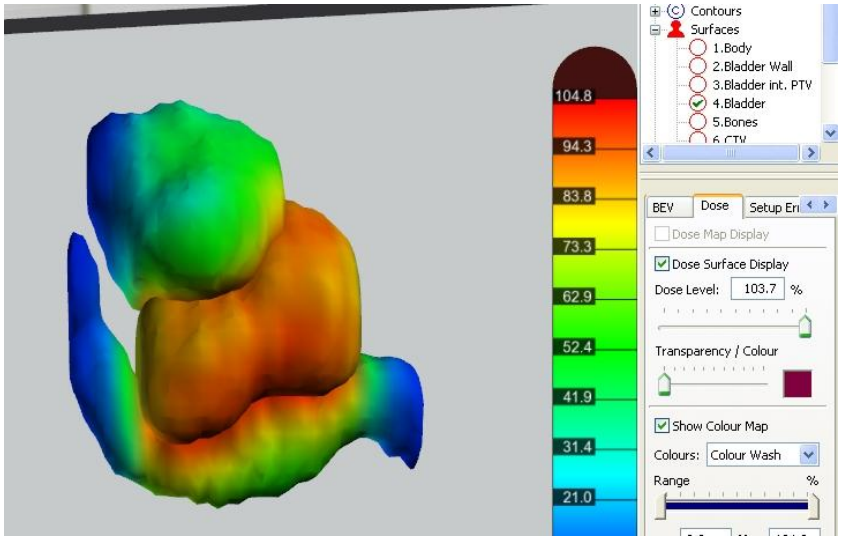


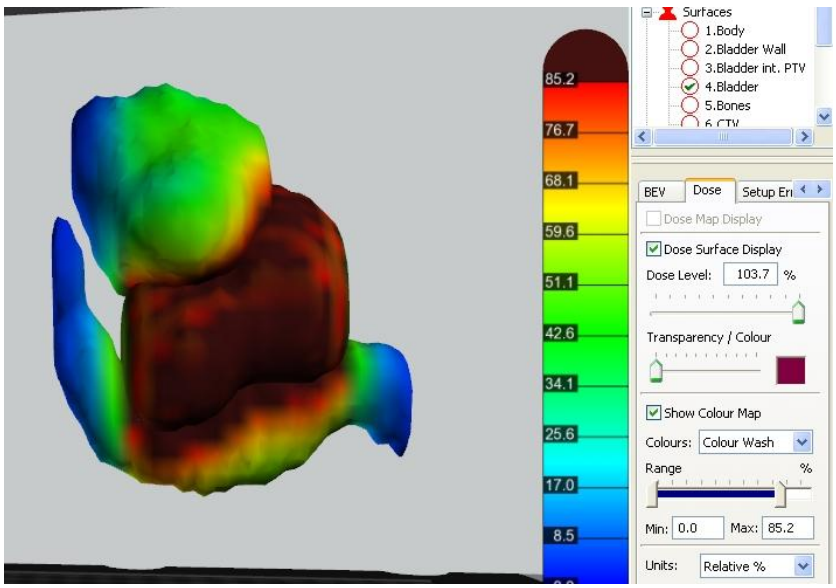
Another dose visualisation option within VERT is the dose colourwash option. Right click on the word structures and select the **Default Dose Wash** option.



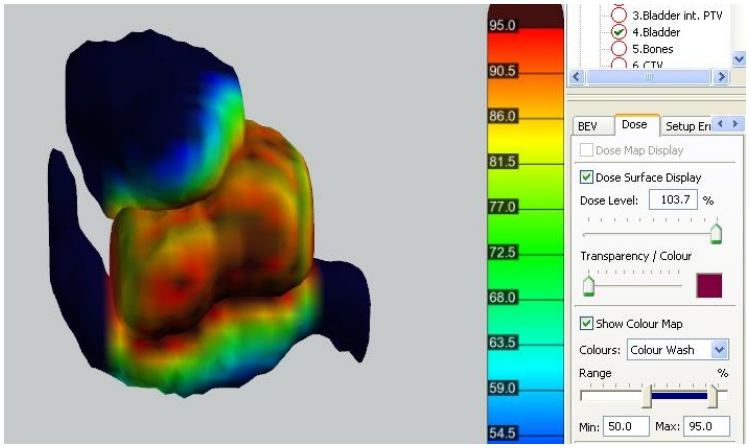
A coloured view of the dose distribution will appear.

Select the **Show Colour Map** option from the dose menu to view the dose values for the colours.

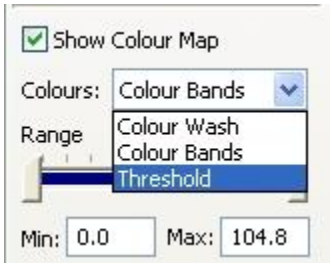




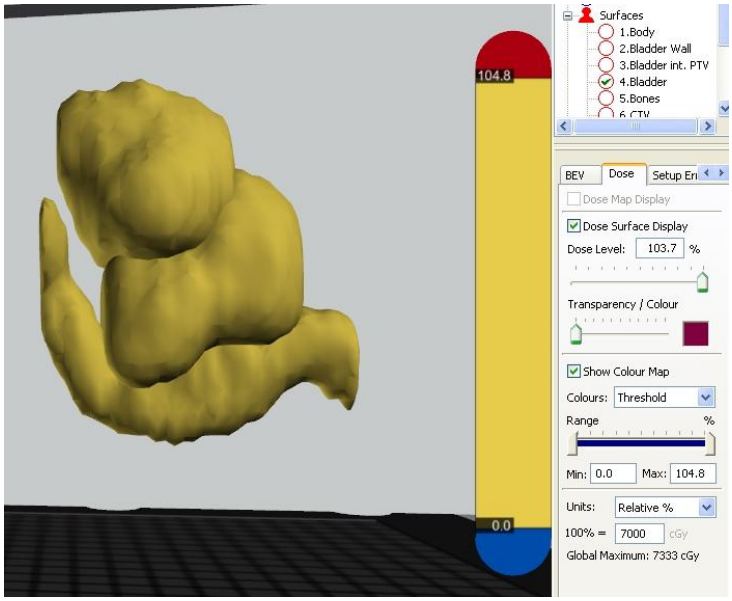
Move the right hand “handle” of the slider in the range window. The dose over the selected value will appear as a dark maroon colour. Now move the left hand “handle” of the slider. Doses below the selected dose value are displayed in dark blue.

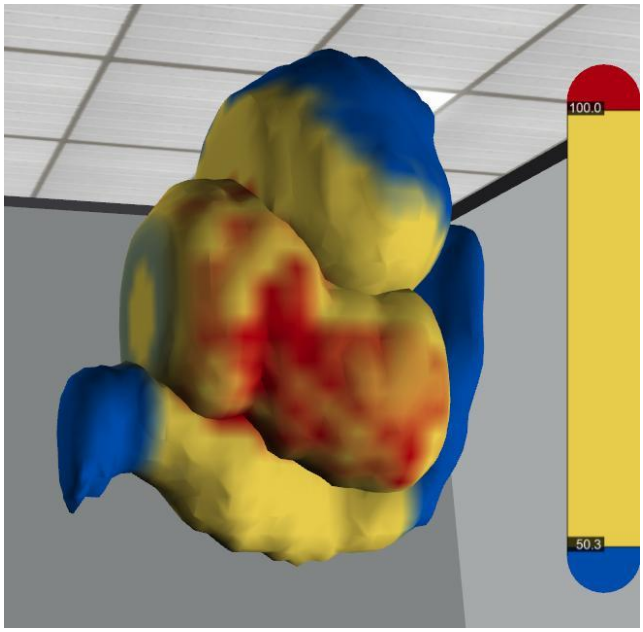


Choose the threshold option for dose colourwash display from the drop-down menu.



The structures will all be yellow. Move the range sliders as before to view dose thresholds.




100.0
50.3

Chapter 6 Viewing ICRU dose levels using VERT

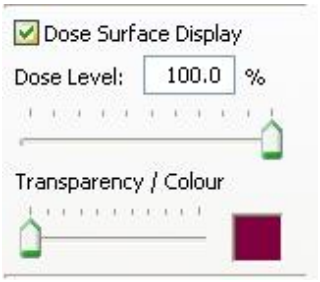
Patient required: any VERT patient

Time: 10 minutes.

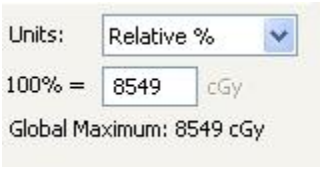
This session will cover the following:

- Entering dose prescription
- Viewing dose values over 100%

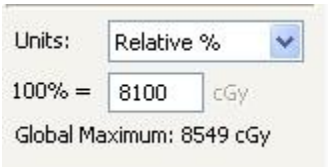
When the dose menu is first selected the dose display will be in absolute mode and the maximum visible dose will be 100%.



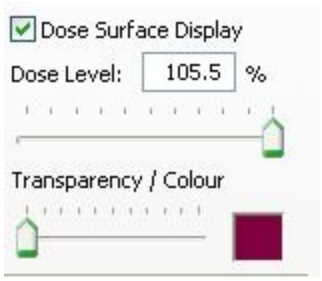
Once relative dose is selected the option to enter the prescription dose becomes available.

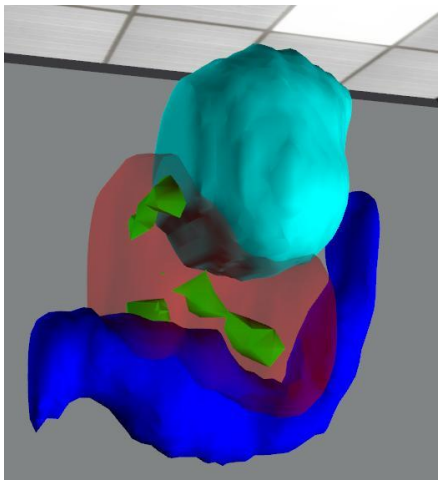


Enter the prescription dose.



Now view values over 100% using the slider bar underneath the Dose level option.


Dose Surface Display
Dose Level:
105.5
%
Transparency / Colour



Chapter 7 Simulated Errors

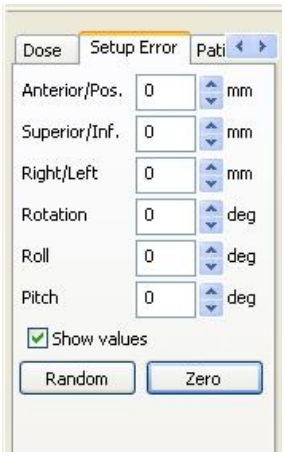
Patient required: any patient loaded onto VERT.

Time: 15 minutes.

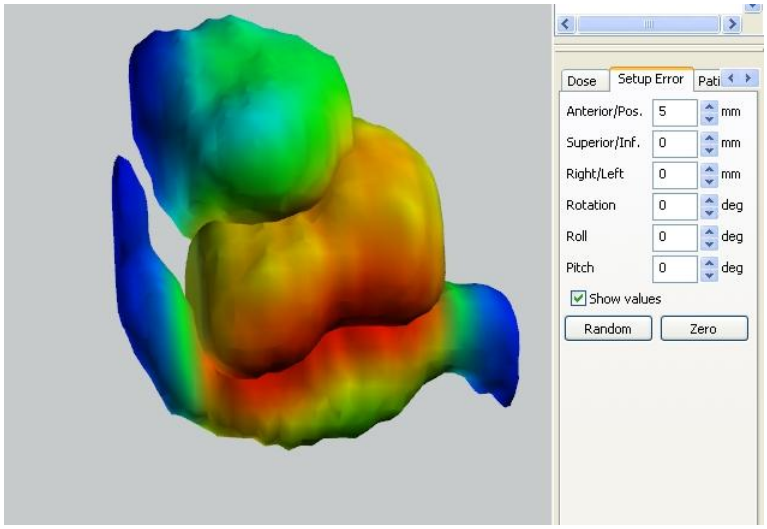
This session will cover the following:

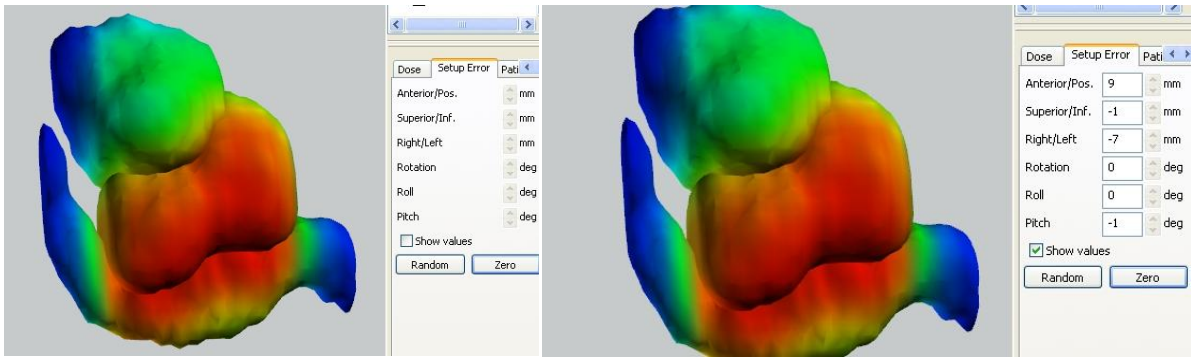
- Setup error menu
- Viewing simulated set up errors using the dose surface and dose cloud display.

The set up error tab is located in the bottom right hand corner of the VERT screen. Use the small arrows to scroll through the options if the setup error tab is not visible.



Enter an Anterior/posterior shift of 5mm and view the dose colourwash display resulting from the shift.

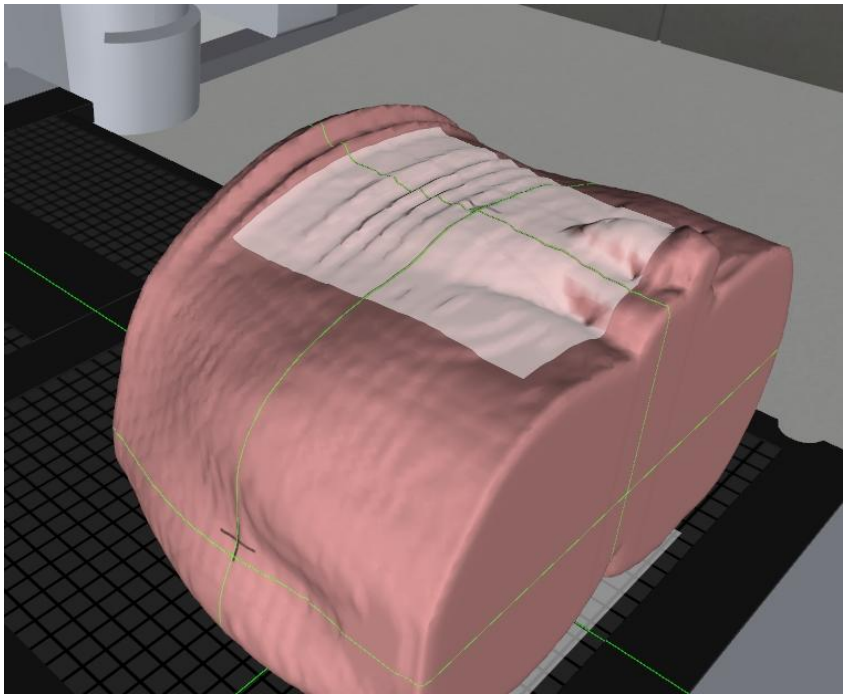




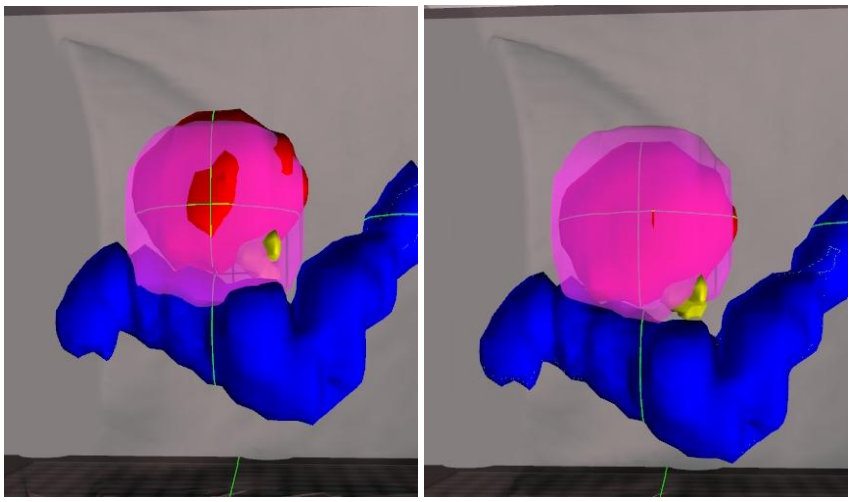
Click the **Zero** button to reset the error and move the patient back to the isocentre position.

Click the **Random** button to generate a random error. The magnitude of the shift can be made visible by ticking the show values box.

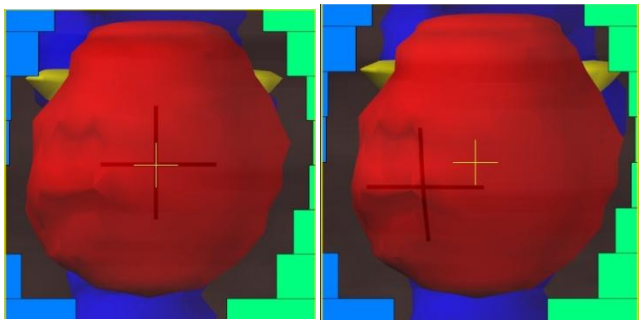
When a setup error is generated the patient moves off the isocentre position so the lasers and field light do not align with the patients marks.



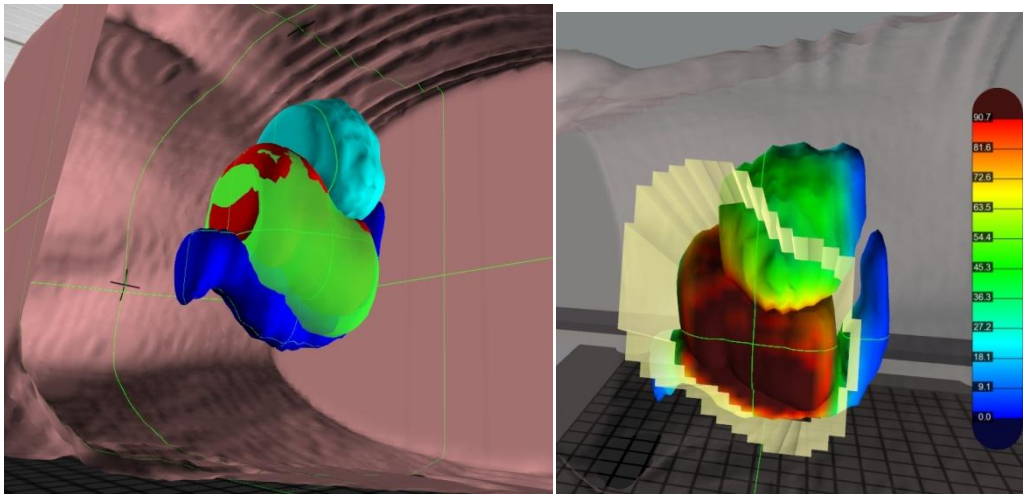
Turn on the dose surface display and then generate an ant post shift. The dose surface will no longer cover the target volume.



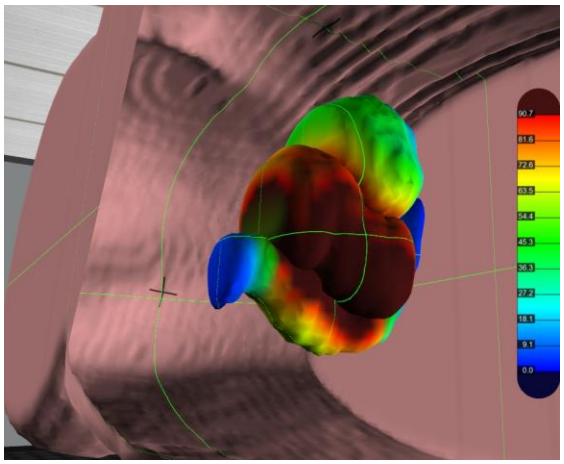
The beams will also not cover the target volume when a set up error is entered into VERT and the Beams eye view will display the field centre and isocentre in different locations as below.



Add the patient outline to a plan with a setup error and view the dose coverage and the location of the lasers with respect to the skin marks.



Turn on a beam and view the beam coverage relating to the target and the increase in the volume of organs at risk within the field.



The set up error option is highly visual when used with the dose colourwash option. Recreate the image above using the colourwash option, the dose slider and the set up error.

Further exercise incorporating the set up error menu is available in Chapter 12 IGRT workflow.

Chapter 8 Virtual Presenter

Patient required: any patient loaded onto VERT.

Time: 30-45 minutes.

This session will cover the following:

- Creating virtual presenter files using camera icon
- Deleting individual slides
- Renaming slides
- Reordering slides
- Adding an image
- Deleting a virtual presenter file
- Starting a new file
- Slideshow storage location
- Creating a virtual presenter file on a laptop and moving to the main VERT system.

Use of the virtual presenter

The virtual presenter can be used to prepare sessions up front. This has the following advantages

- Time saving, less mouse clicks to get to what is required.
- A “way pointer” to the next discussion point.
- Delivery by anyone with facilitator notes.
- Saves scenes (points in time) in the software.
- Allows the presenter to focus on teaching rather than on the software allowing more time to spend on explaining, less on driving the software.
- Can reduce the pressure of driving the software “live”.

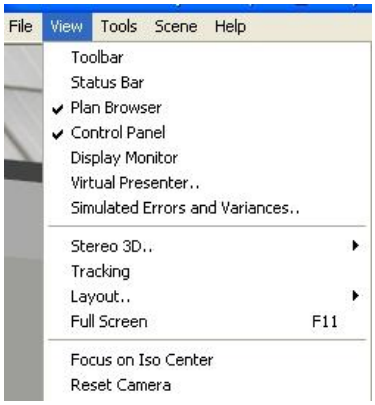
Reminder: the scenes created are not a fixed jpeg image, the software options can still be selected in the usual way and the view manipulation tools are still active. The scenes are a starting point to begin explaining concepts.

The virtual presenter is Patient specific, two patients cannot be combined into the same slideshow file and two plans for the same patient will also require separate slideshows.

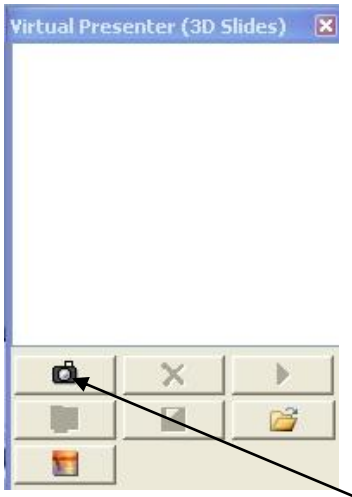
The file created is machine specific.

Introduction

Access the virtual presenter option from the view menu:



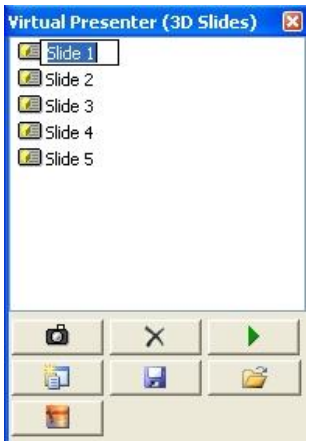
The following window will open:



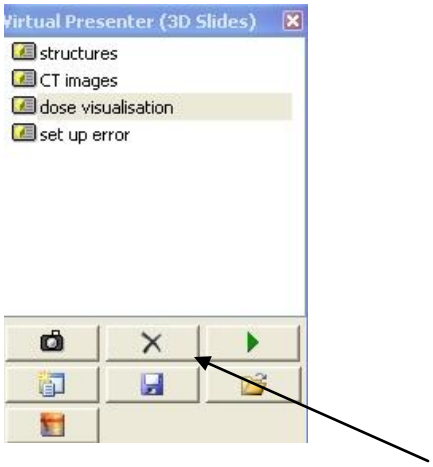
To create a virtual presenter slide click the camera icon

Create 5 slides for a Virtual Presenter file

Rename each slide: to do this click the left mouse slowly twice on the slide name.

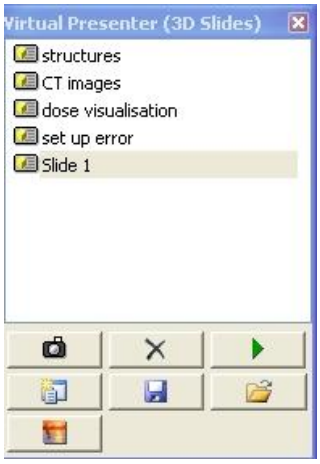


Delete the 3rd slide

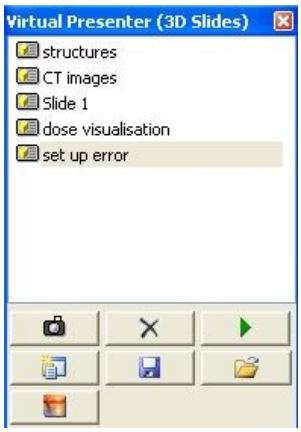


To delete a slide highlight the slide for deletion using a left mouse click and then push the cross button.

Recreate a slide to replace the 3rd one. The last slide created will always be placed at the end of the list.

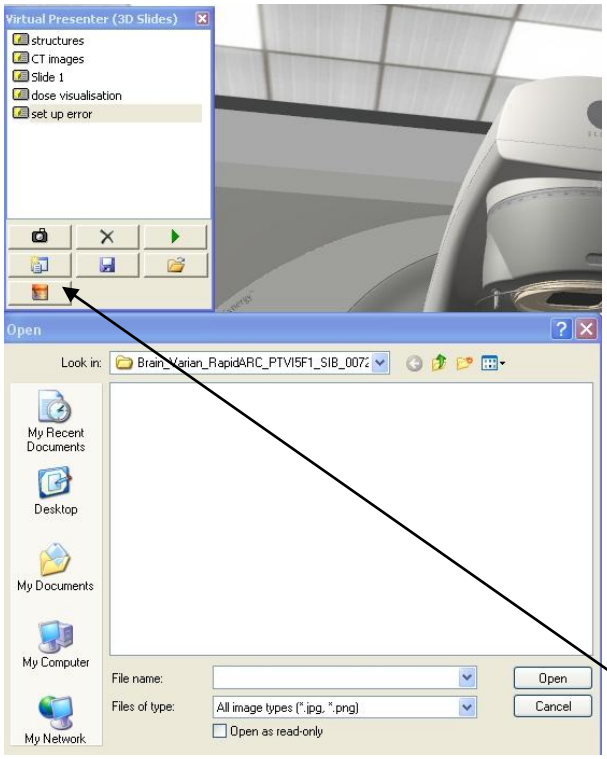


Reorder the slides so the 3rd slide is now labelled slide 1. To do this pick the slide up with the left mouse and drop it in the slide name in the position you would like it be in.

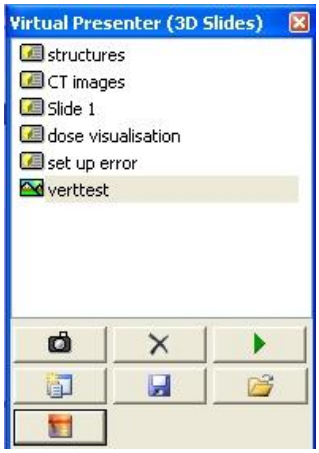


Inserting pictures

Insert a photograph into the slideshow. To do this use the insert picture button at the bottom left of the menu on the third row.



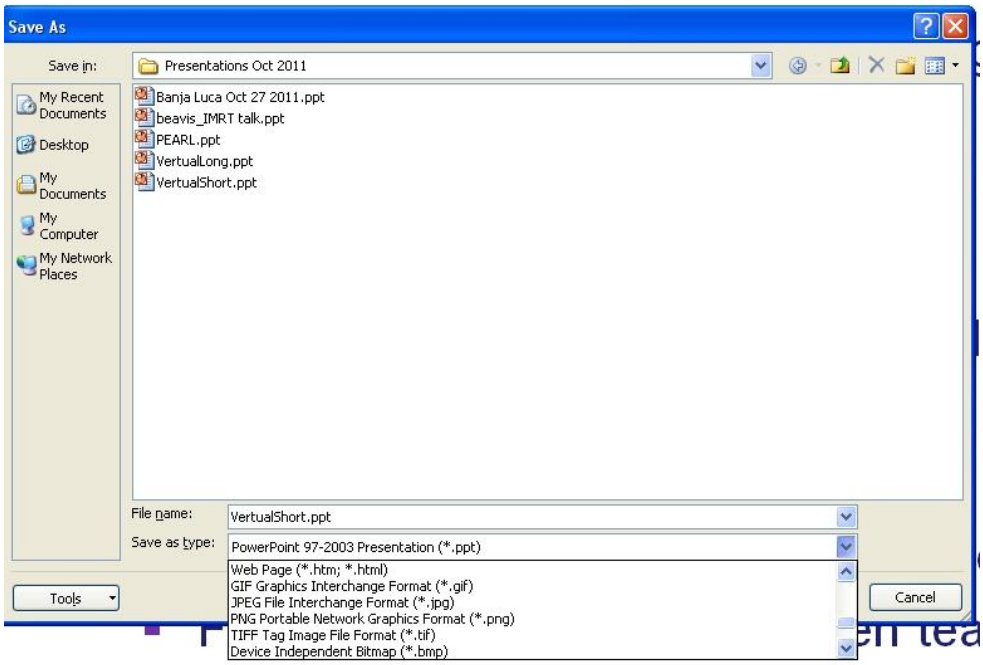
Insert picture: the windows explorer box will open. Go to the directory containing the image you wish to use and click open.

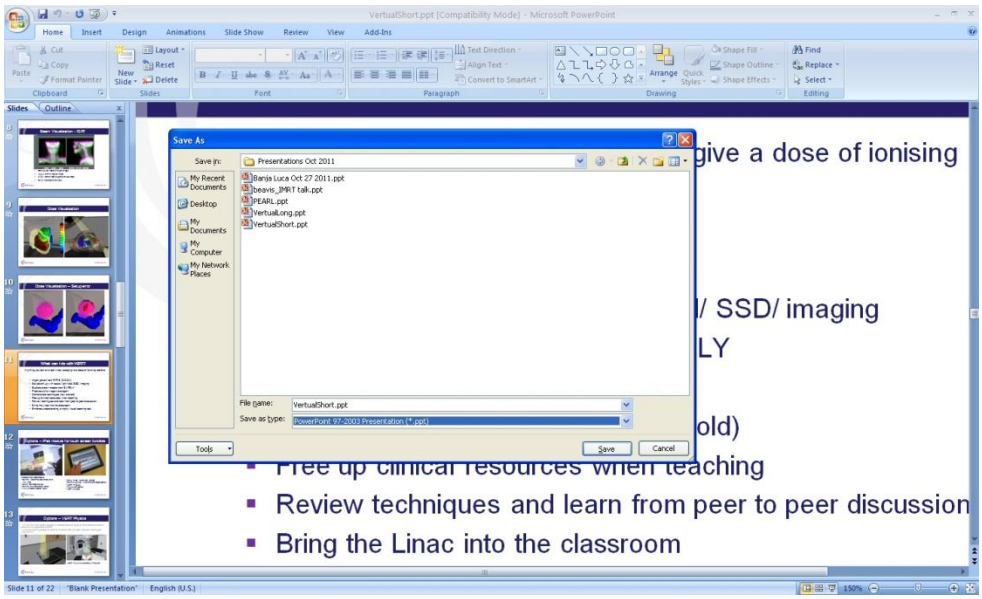


The picture will appear in the bottom of the list.

PowerPoint slides can also be inserted as JPEG images enabling theory and demonstration of practice to be put together during a session.

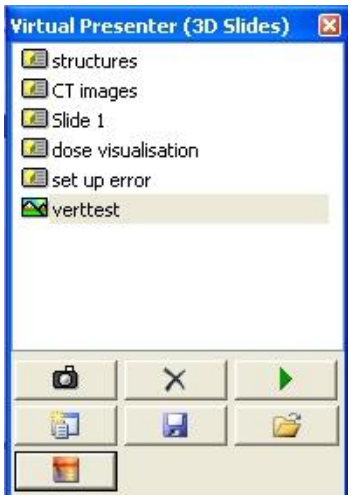
Insert a PowerPoint slide by first saving the PowerPoint slide(s) needed as JPEGs from within the PowerPoint application. Use the save as option and scroll down the list of formats until JPEG is visible; this option is near the end of the list.



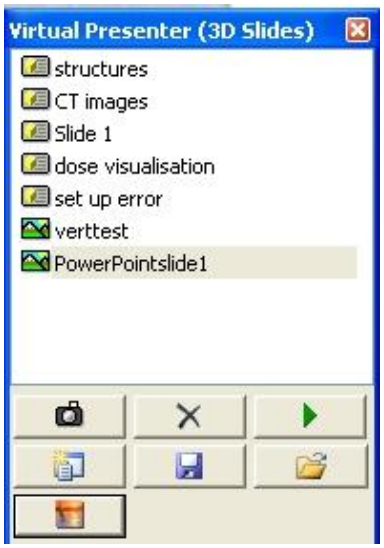


Microsoft Office PowerPoint
Do you want to export every slide in the presentation or only the current slide?
Every Slide
Current Slide Only
Cancel

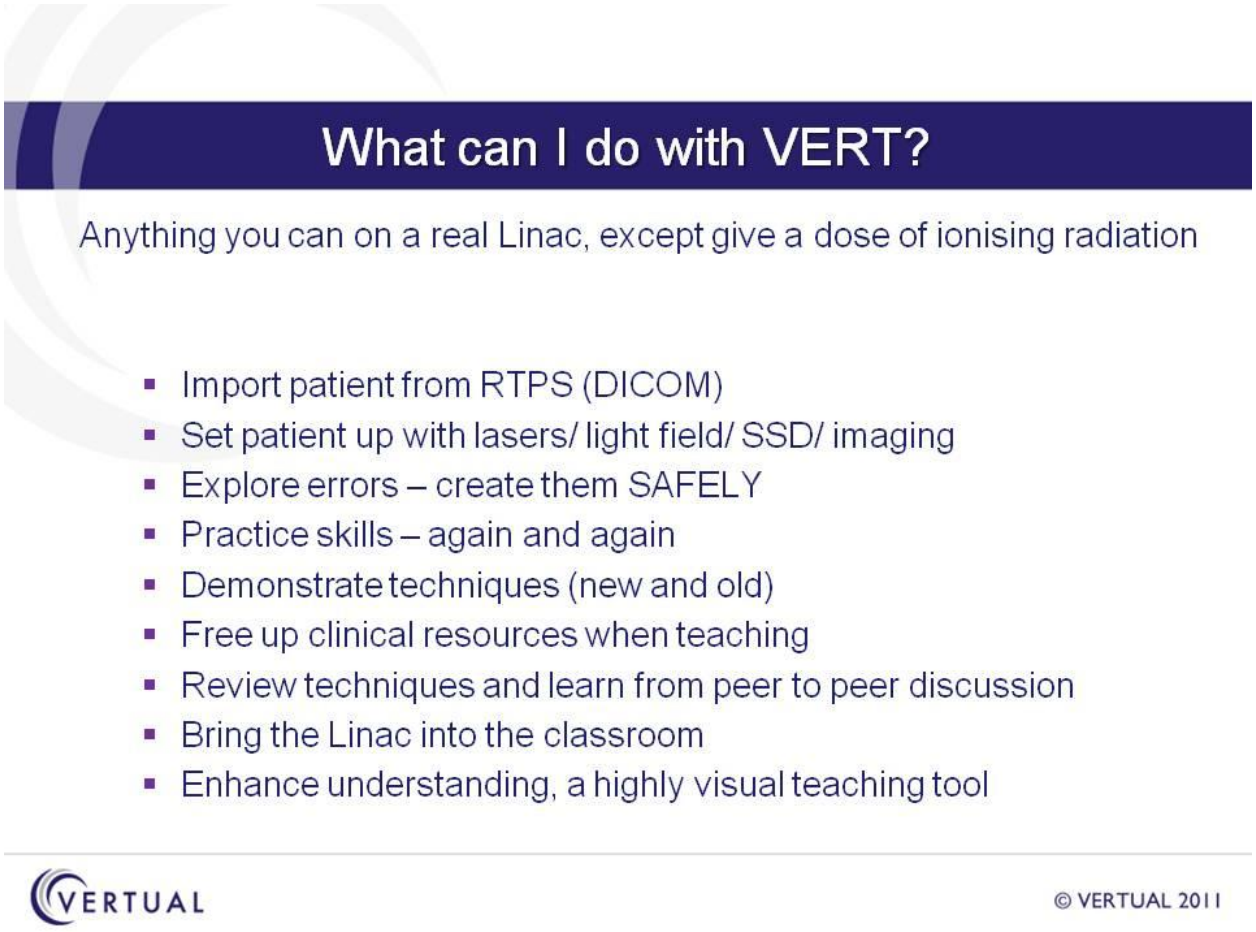
The following dialogue box will then appear. Select the current slide if only one slide is needed or select the “every slide” option for all. Remember where you save them.



Use the insert picture option as before to load the JPEG images of the PowerPoint slides from their saved location.



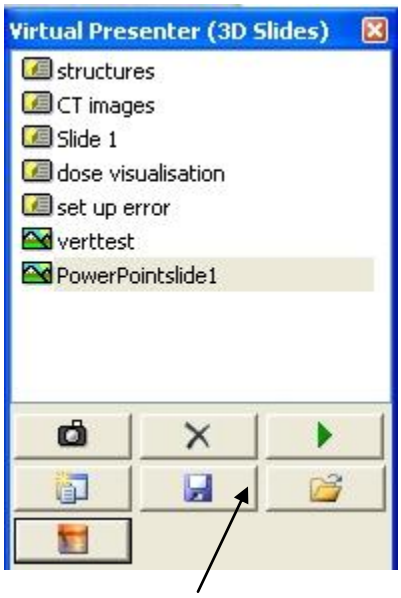
The PowerPoint slide is now inserted into the virtual presenter file.


What can I do with VERT?
Anything you can on a real Linac, except give a dose of ionising radiation
Import patient from RTPS (DICOM)
Set patient up with lasers/ light field/ SSD/ imaging
Explore errors – create them SAFELY
Practice skills – again and again
Demonstrate techniques (new and old)
Free up clinical resources when teaching
Review techniques and learn from peer to peer discussion
Bring the Linac into the classroom
Enhance understanding, a highly visual teaching tool
VERTUAL
© VERTUAL 2011

The PowerPoint slide will appear in the main VERT window when selected.

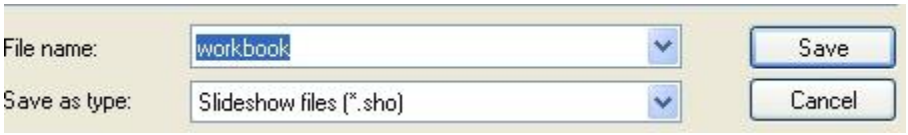
Saving the slideshow

Save the virtual presenter (slideshow file – all virtual presenter files have the file extension .sho) using the disk icon.



Save slideshow file

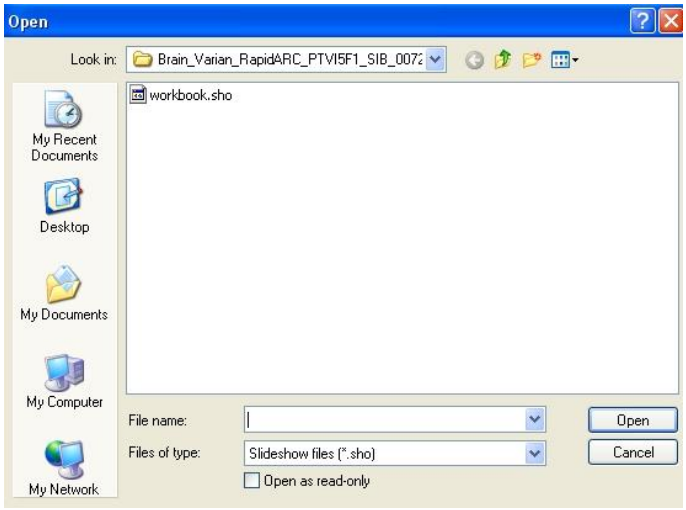
The system automatically chooses the correct directory to save the slideshow file into to make the file available to load easily into the patient during future sessions.



Give the file a name and click save.

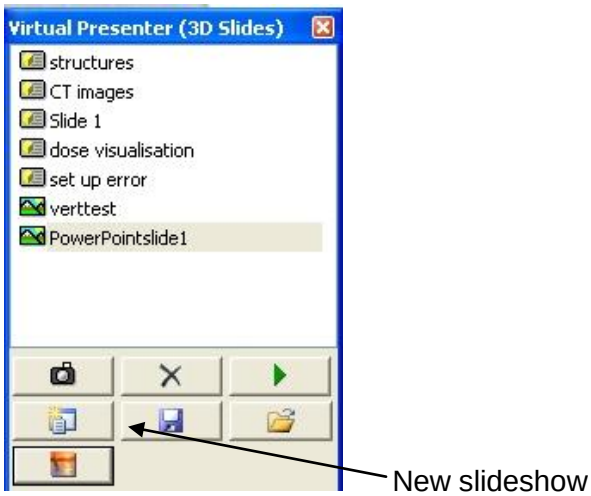
Now exit the patient, reload the patient using the file import option and re- open the Virtual presenter (slideshow) file using the open folder option in the virtual presenter menu.

The following window opens. Select the file you wish to open and click the open button.

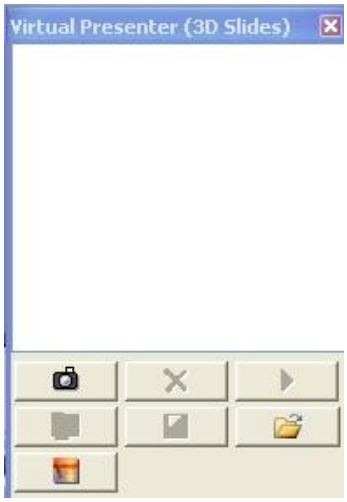


Creating a new slideshow

If you want to create another slideshow file or replace the current slideshow file click the new button on the virtual presenter menu.



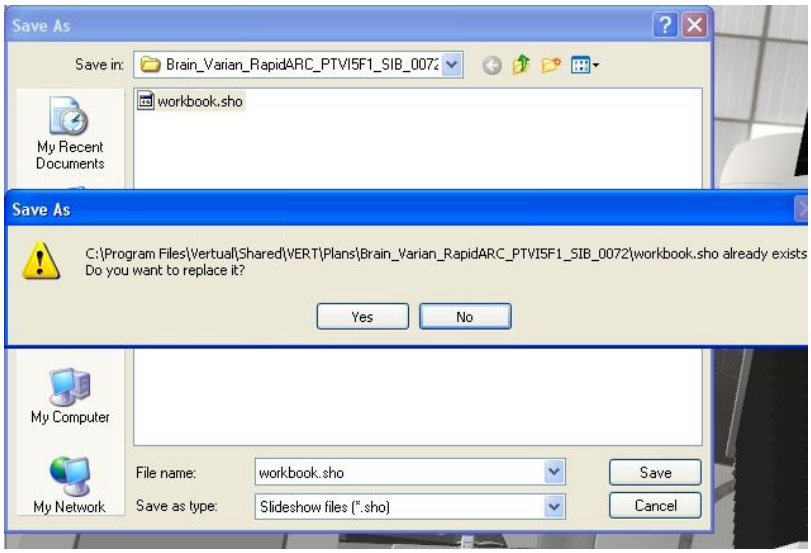
The following message appears. This will not replace the existing slideshow files it will only make the virtual presenter window ready for new slides. The previously created slideshow files will be available when clicking the open folder option.



Create 3 slides.

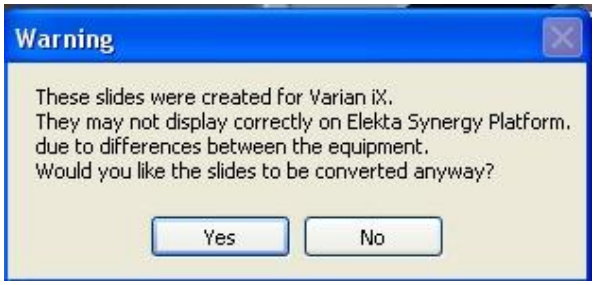
Click the save button and

1. To replace the existing slideshow file save with the same name as before and say yes the following message



2. To create a new file use a unique name and click save.

   Virtual presenter files are machine specific although slides created for a Linac can be loaded when a different Linac is visible. The follow message will appear in this case

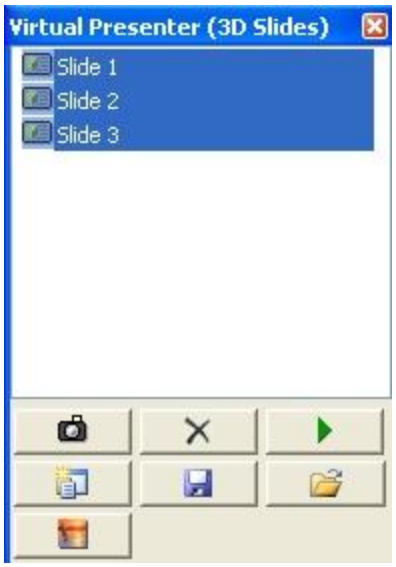

Warning
These slides were created for Varian iX.
They may not display correctly on Elekta Synergy Platform.
due to differences between the equipment.
Would you like the slides to be converted anyway?
Yes
No

   This will convert the slides. Please be aware that any slides saved with the beams eye view will display the collimator of the Linac they were saved for.

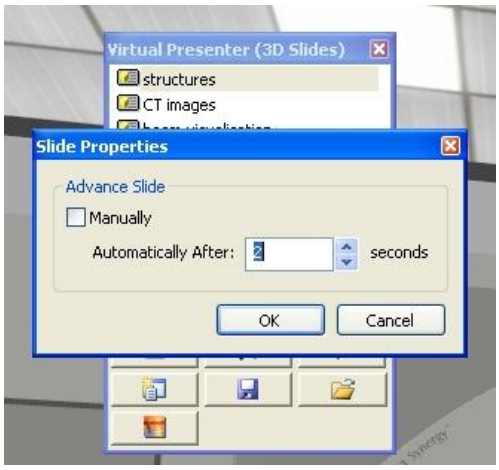
Using automatic timings to run through the virtual presenter slides

The option is available to set a time for each slide to run instead of using the manual option. This allows hands free presenting.
If a question is asked and the slide changes before the presenter is ready just click on the slide you wish to start from and press the play slides button once again.

To set up timings for the slides either click one slide to set timings individually or select all the slides in the list by holding the shift key down and clicking the first and last on the list.



Use a right mouse click to open the slide properties window.



Insert the time needed for each slide and click OK.

Select the green arrow to choose the slide animation option. The slides will run through from the current highlighted slide or from the beginning using the selected timings.

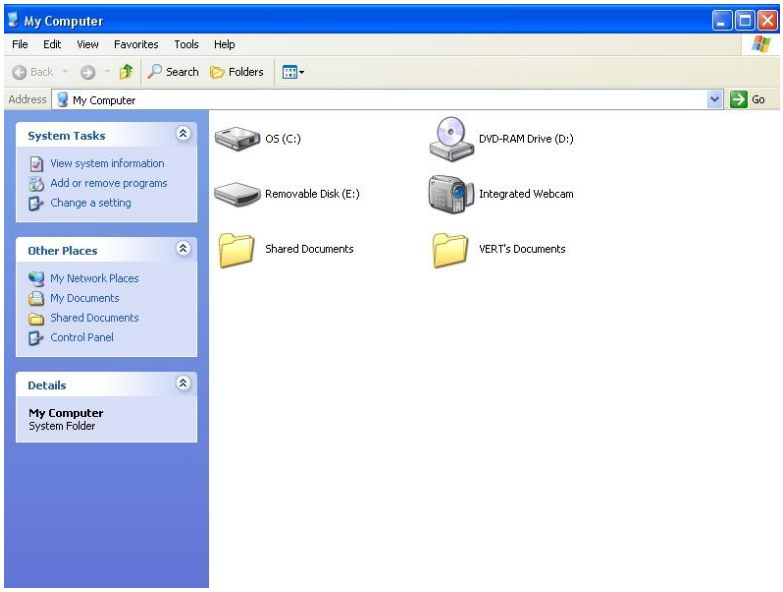
The progress is shown in the green circle on the right hand slide of the main VERT screen.

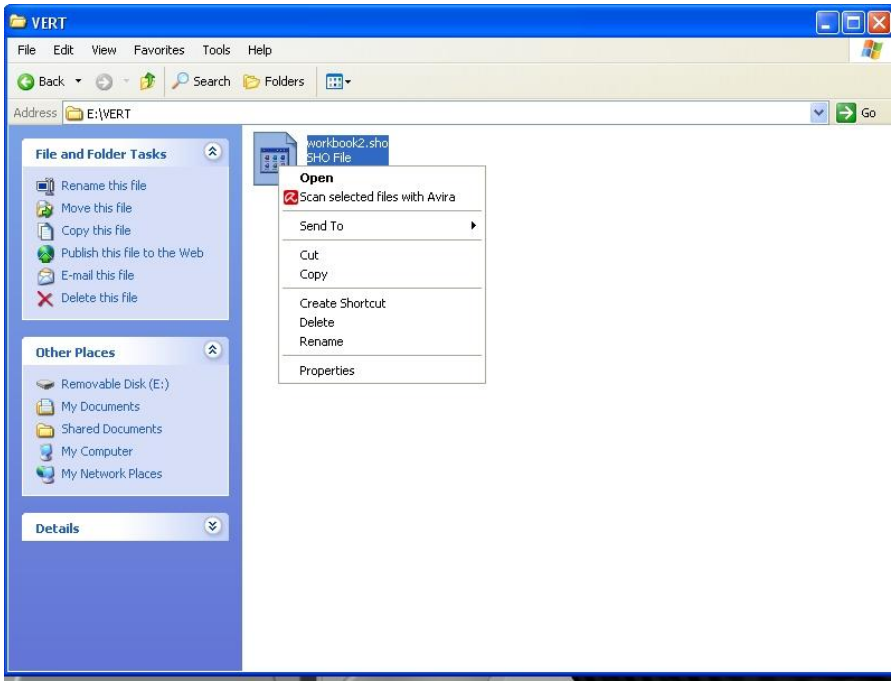
Creating a slideshow file

Creating a slideshow file on a laptop or separate PC from the main VERT one and loading onto the main VERT PC:

Create a slideshow file on the remote PC and save onto a USB stick/jump drive or CDROM. This example has the filename workbook2.sho

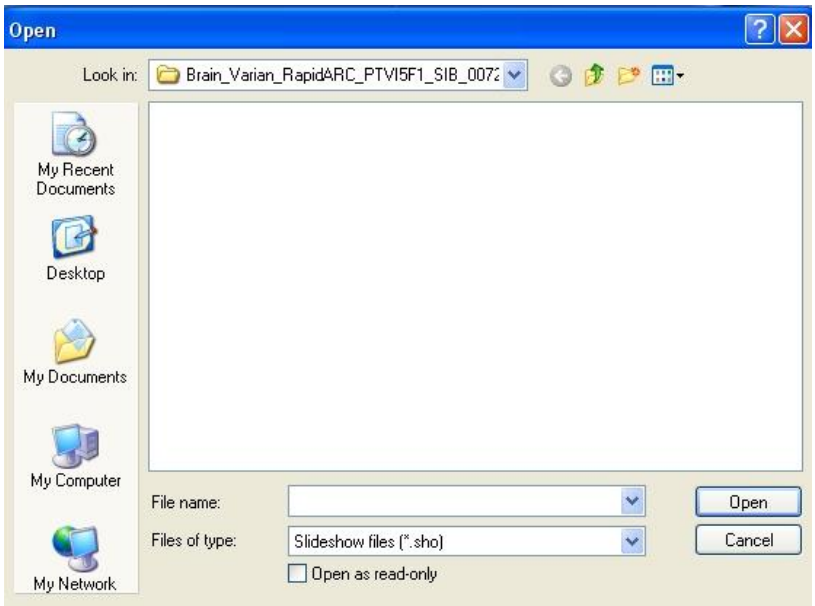
Insert the drive into the VERT PC and open the directory containing the file

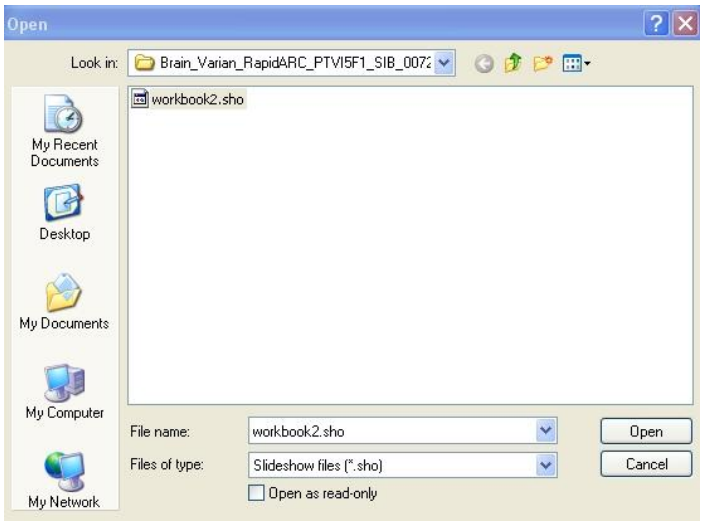




Right click on the file and select the copy option

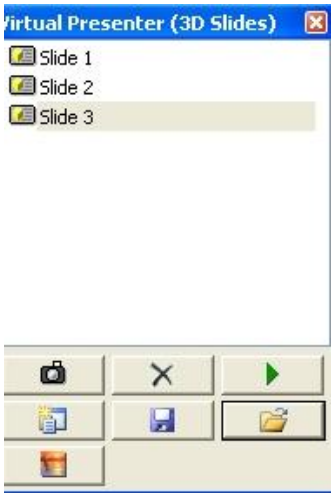
Open the folder icon in the virtual presenter menu and click paste in the window





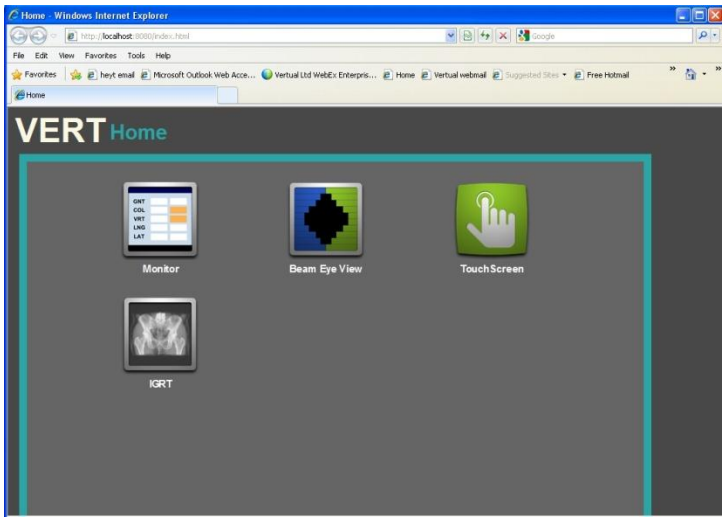
Select open and the slides will be present as usual.

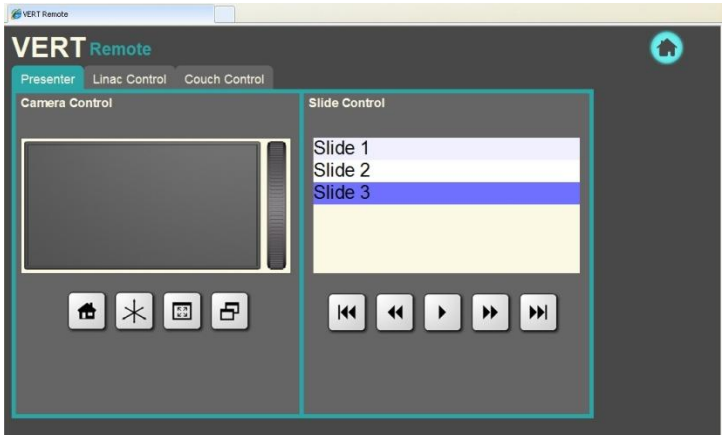
N.B When creating a slideshow file on a remote machine any pictures (e.g. JPEG images) will need to also be saved and reloaded into the slideshow file on the main VERT system. The images are not actually saved in the slideshow file, only the link is saved.



The virtual presenter slides can also be advanced using the touch-screen display on a touch-screen PC installed with the main VERT system, or Apple iPad (this iPad option requires additional software)

Select the touch-screen option (see VERT user manual or ask trainer how to do this) and then select the slides on the right hand side to advance them.



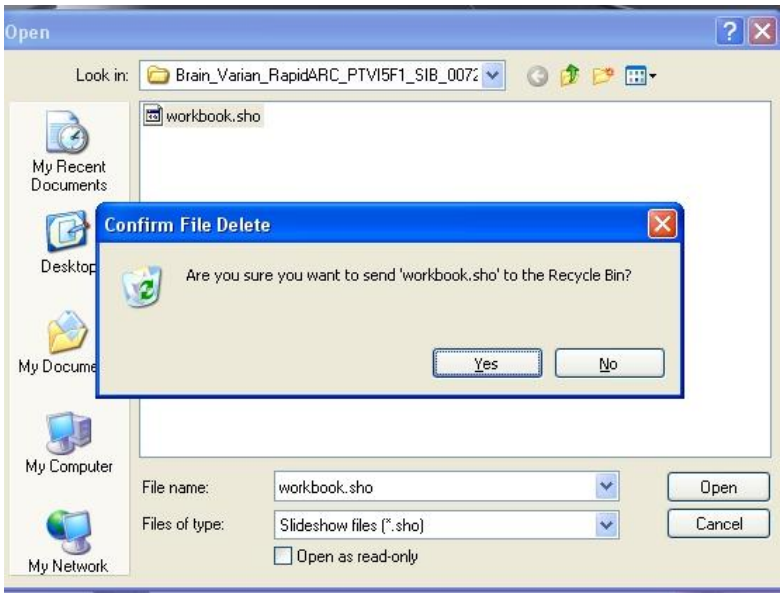


Virtual presenter slides can also be advanced using the buttons on an xBox controller. Separate instructions are available to install this option.

Deleting a Virtual Presenter file.

To delete a file overwrite an existing slideshow file using a new slideshow with the same name.

Open the open folder option and select delete on the keyboard. The following message will display. Select yes and the slideshow will be deleted.



Chapter 9 Radiation therapy concept visualisation using VERT

Patient required: block patient

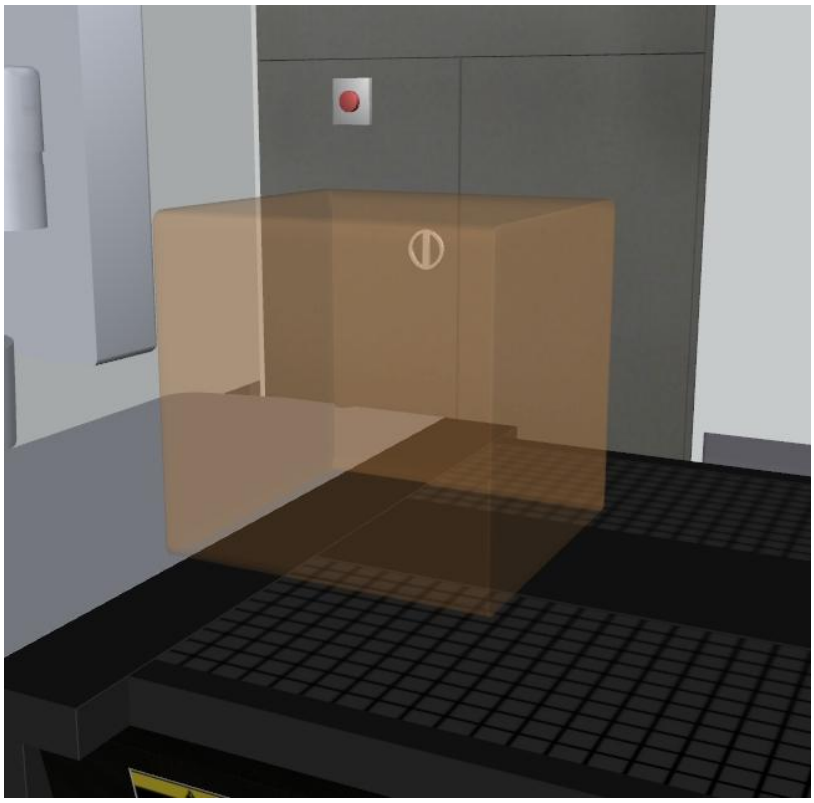
Time: 15 minutes

This session will cover the following:

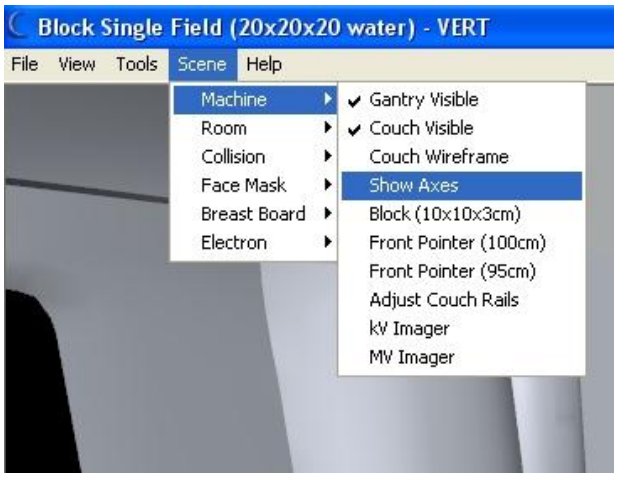
- Isocentre visualisation using axis feature
- Front pointer
- Full length/shortened
- Skin marks
- View skin marks from inside the patient
- Patient separation
- Anti- collision
- Isocentre visualisation using axis feature

Isocentre visualisation using axis feature

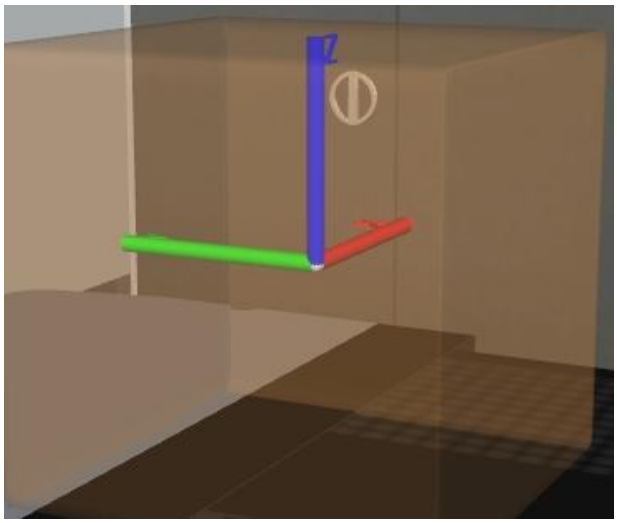
Load the block patient.



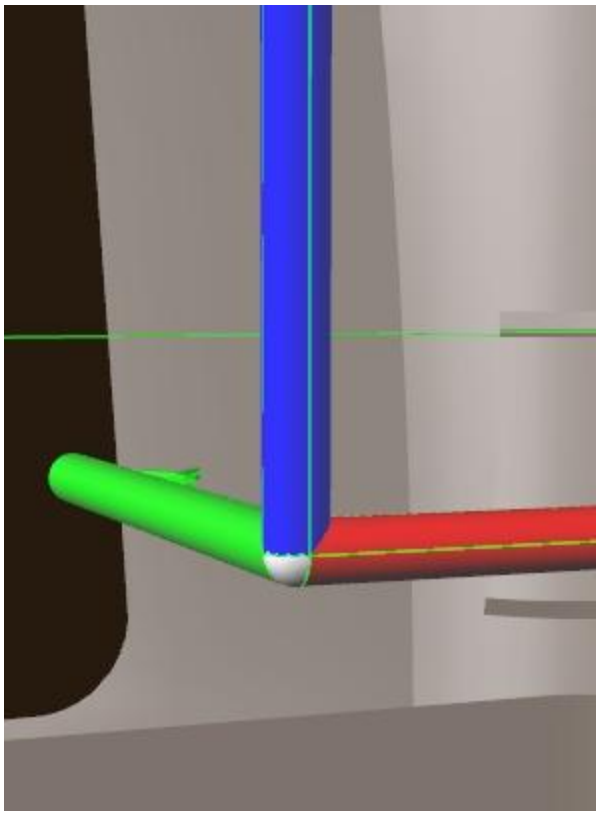
Turn on the axis feature from the scene, machine menu.



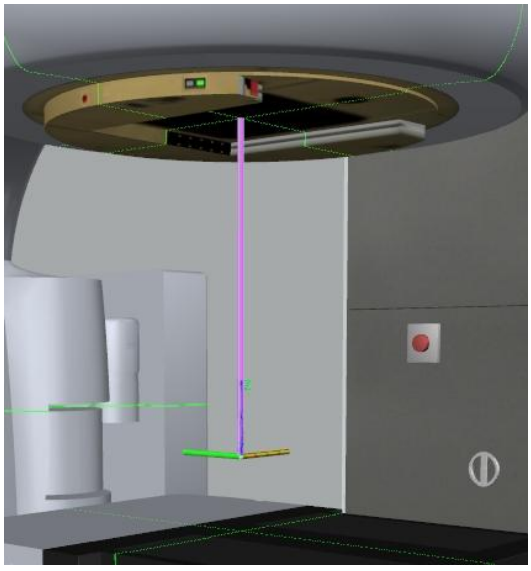
The axes appear at the patient isocentre.



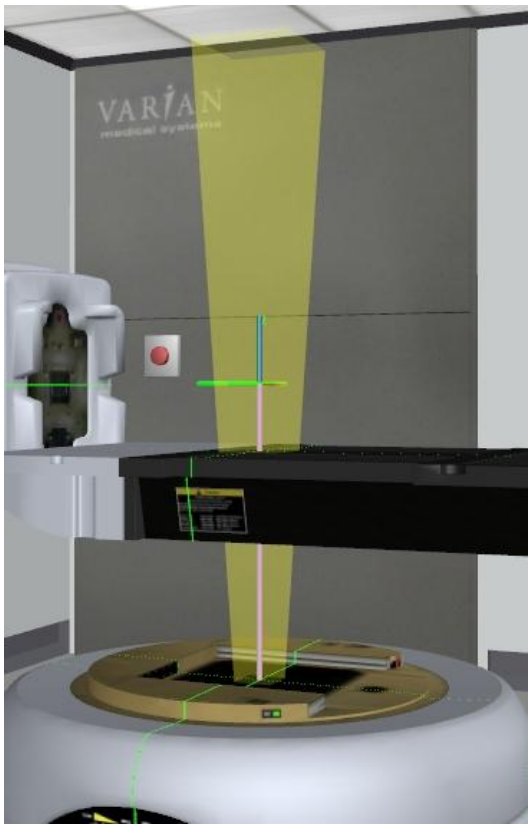
Turn on the lasers and see the isocentre sphere co-incidence with the lasers.



Turn on the front pointer using the Scene... Machine... Front pointer 100cm option

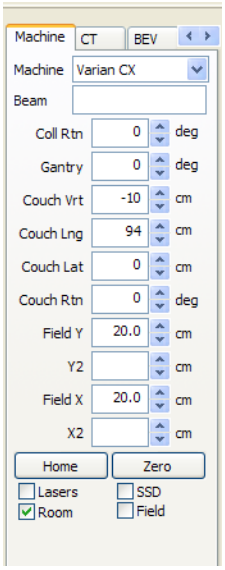


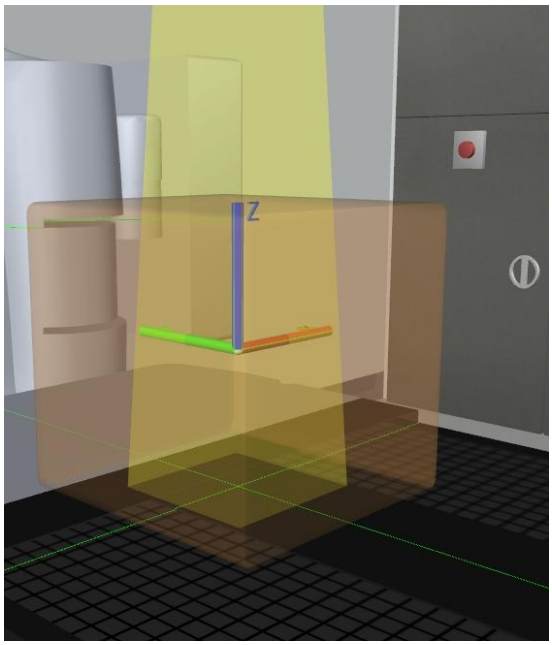
Click with left mouse on beam 1 to view the beam. Select the machine tab and type 180 into the gantry angle.



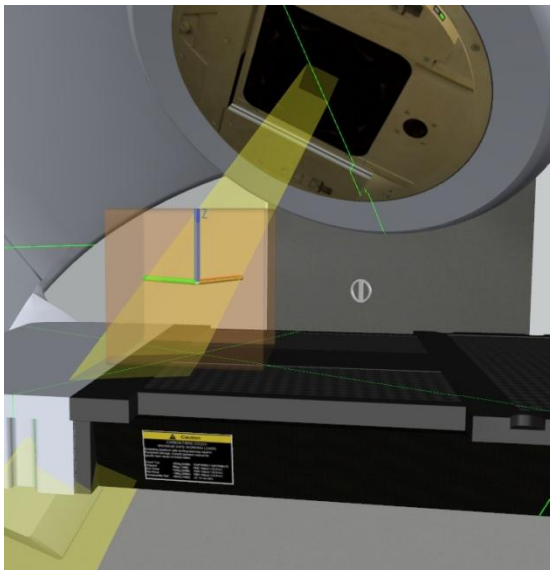
Select the patient surface and make the patient 20% transparent to see the axes inside the patient. The patient and axes and the beam are now visible.

In the machine tab click the home button. This sends the machine to the isocentre location for the patient and sets the gantry angle to zero.





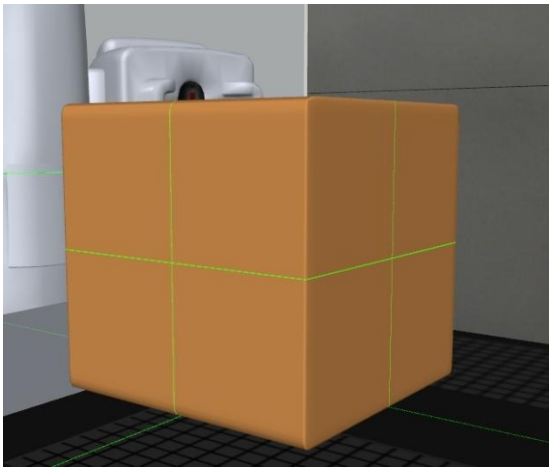
To demonstrate the beam isocentre rotate the gantry collimator and couch.



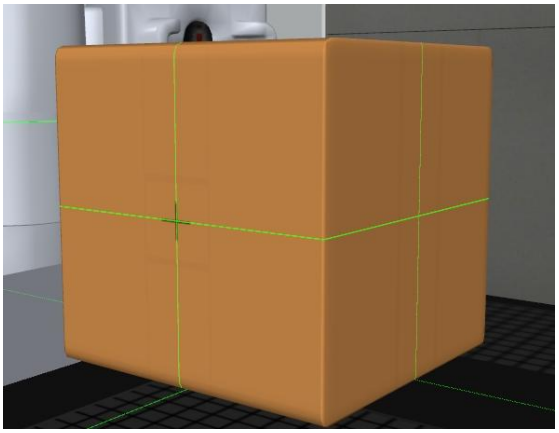
Turn the beam off by clicking “beams” once.

Demonstrating isocentre location within the patient

1. Select the patient surface and make it opaque. The lasers should be on.



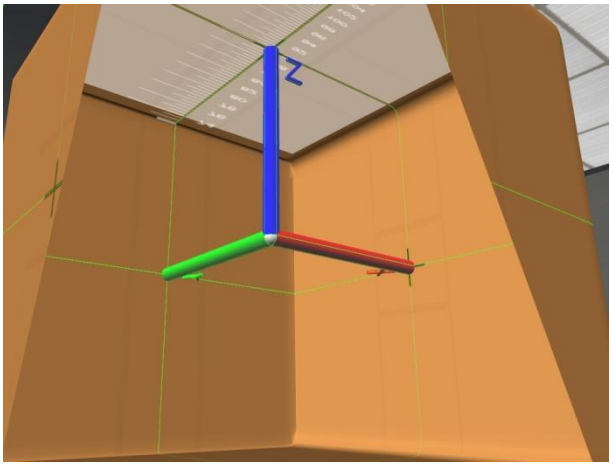
2. Turn on the patient's skin marks (isocentre marks) using the tools, apply skin marks option.



The lasers will line up with the markers on the patients skin.

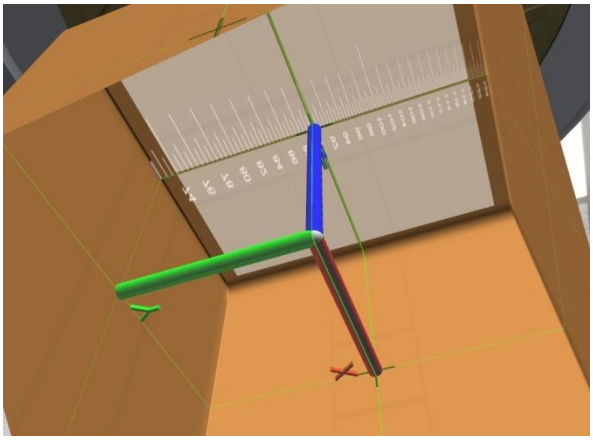
3. Turn on the field light and SSD to show how the patient can be set up.

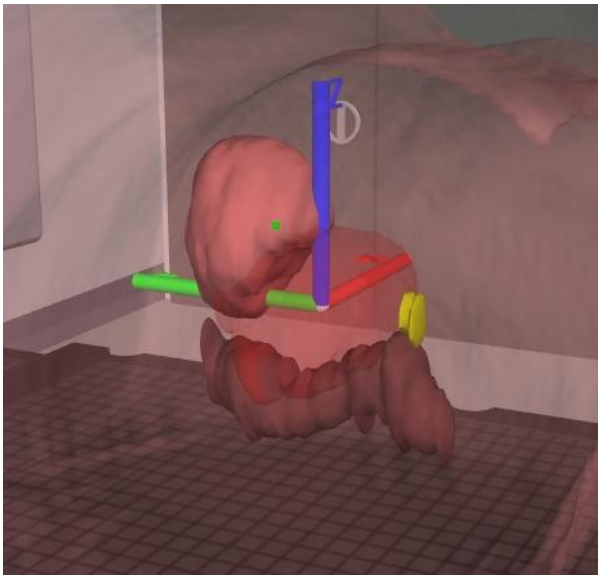
4. Zoom inside the patient by pushing the mouse away from you to “drive in” to the view.



5. The relationship between the isocentre, lateral and anterior skin marks is now visible.

Different angles will show this relationship well.

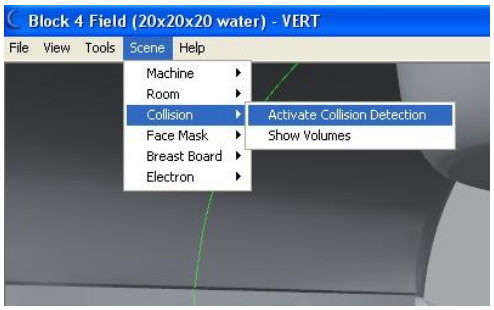




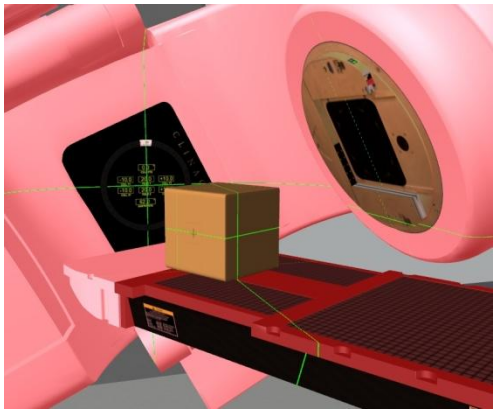
When choosing another patient with a target volume, make the PTV transparent and turn on the axes. The isocentre for the plan is clearly visible.

Demonstrating the Anti-collision option within VERT

1. Activate the anti-collision option in VERT by selecting **Activate Collision Detection** from the scene menu.

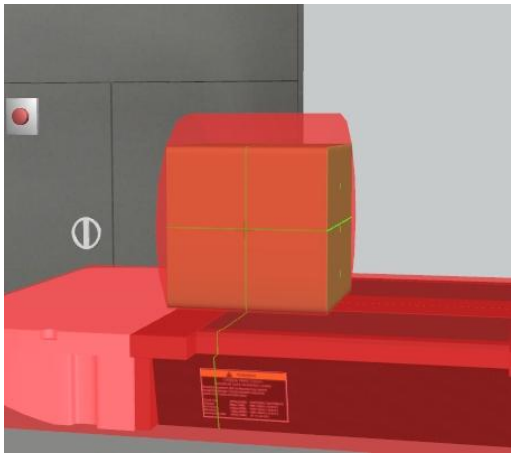


2. Rotate the gantry, collimator and couch to cause a collision.

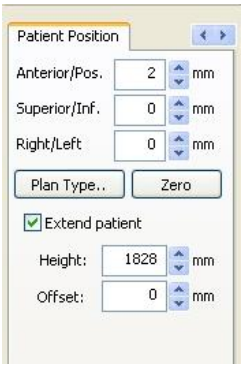


The gantry and couch will appear red and an alarm bell will sound on collision.

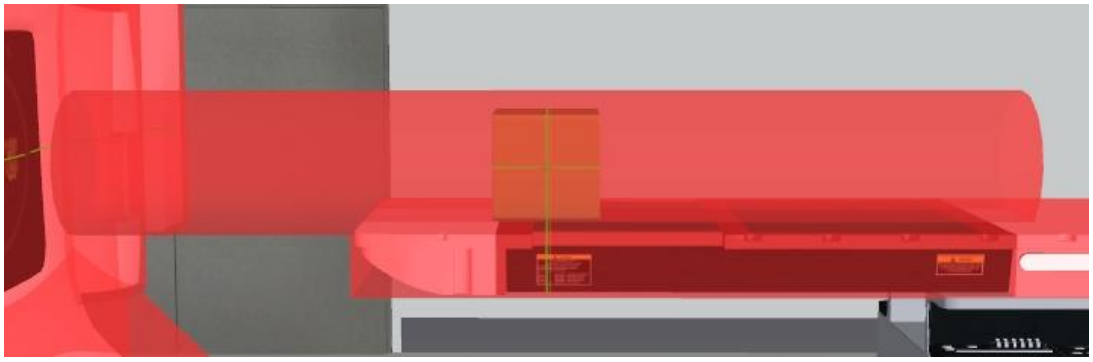
A margin is allowed around the machine and also around the patient. The show volumes option is seen below with the patient margin. This “show volumes” option is not usually needed in normal VERT operation.



3. To extend the patient so a “full length patient” is taken into account, select the patient position tab and extend patient volume.



This option ensures that when the area of collision is outside the CT slice set the collision will still be shown.



Chapter 10 Demonstrating patient separation using VERT and a block

This exercise provides an example of how VERT may be used to demonstrate the concept of separation to students. This example may also be useful to explain SSD field and isocentric fields.

Patient required: the Block demonstration patient from the CDROM.

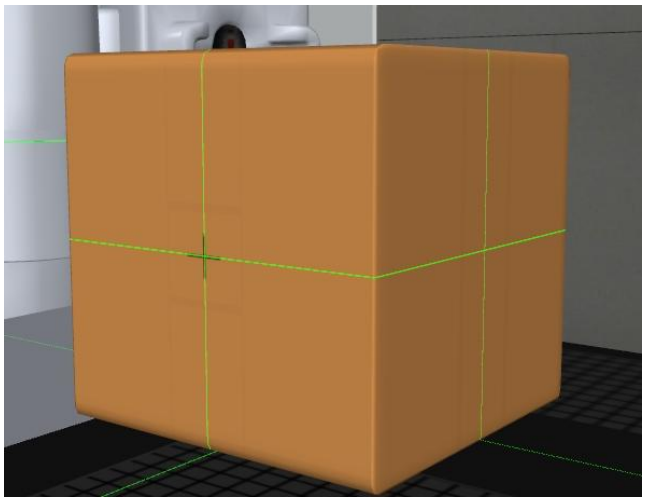
Time: 10 minutes.

This session will cover the following:

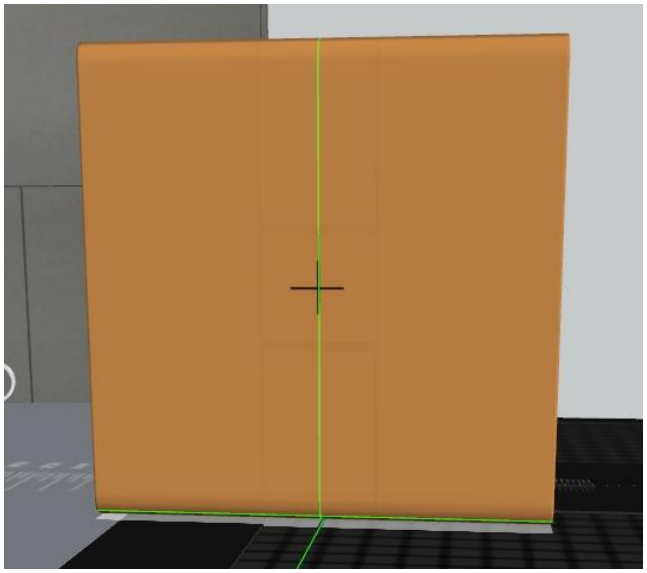
- How to show the separation easily using VERT

Procedure

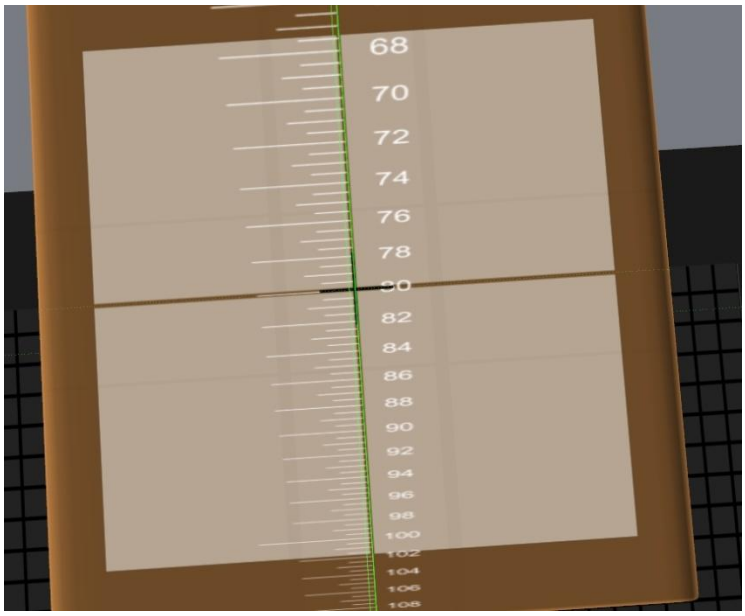
1. Import the block patient. Turn on the skin marks and the lasers



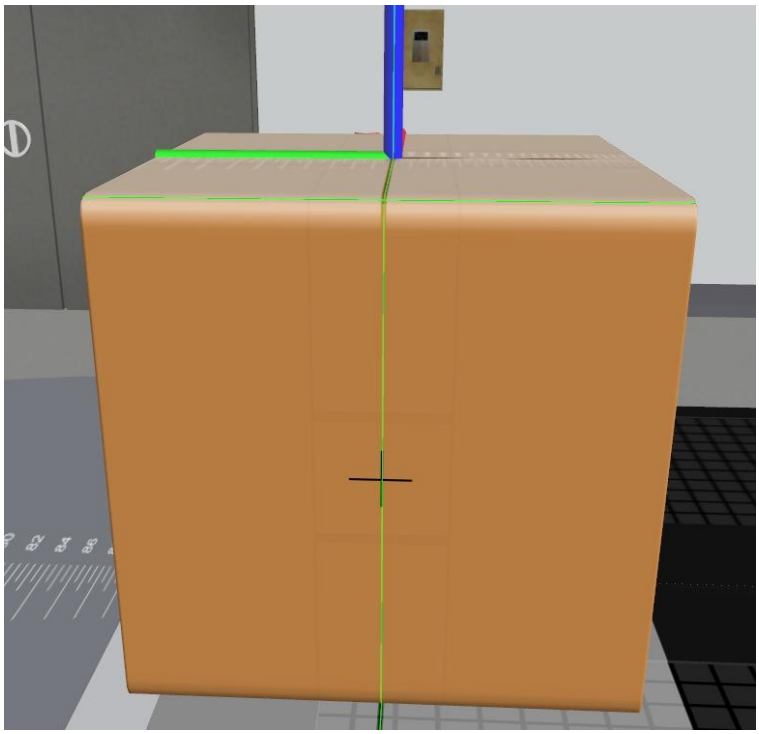
2. Raise the couch so the lasers are positioned on the couch surface



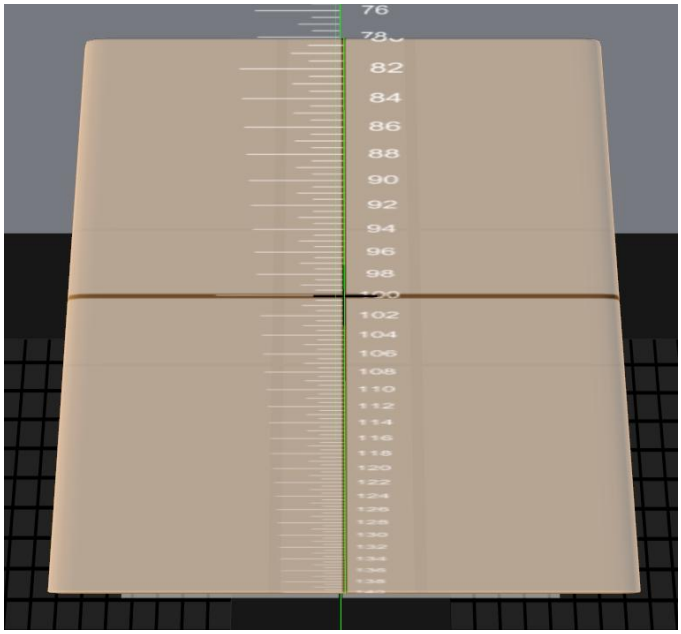
3. Turn on the field light and SSD indicator and read the value. This is 80cm



4. Drop the couch so the laser is level with the surface of the patient



5. Read the SSD value



6. The value will be 100cm.

Therefore the student will be able to see that 100cm – 80cm = the patient separation

In this case it is 20cm

When positioning the patient so the isocentre crosses line up the pin reads 90cm equal to half the patient separation.

Chapter 11 Making shifts from an origin marker

Patient required: any patient loaded onto VERT.

Time: 20 minutes

This session will cover the following:

- Display of skin marks

The skin marks of the patient can be accessed using the Tools menu from the top left hand set of menus on the VERT screen. The Apply skin marks option actually turns on the isocentre of the patient.

To use VERT to setup to a reference mark such as a tattoo or permanent marker the following methods can be used.

Method 1 – Patient has markers created and exported from the treatment planning system

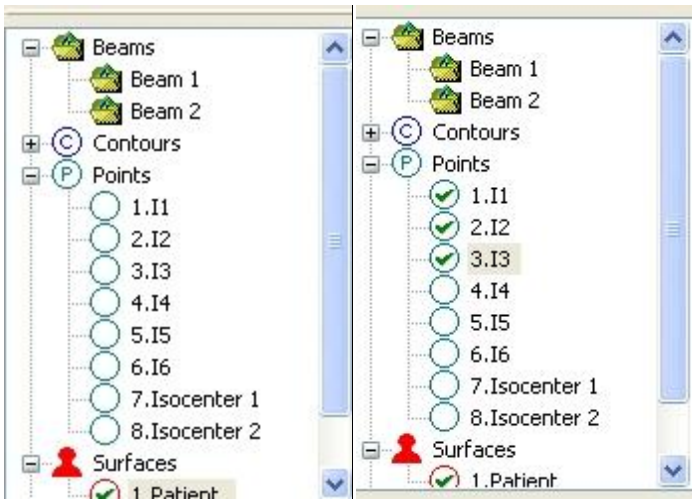
Method 2 – No markers are exported from the treatment planning system.

Method 1 (plan contains markers)

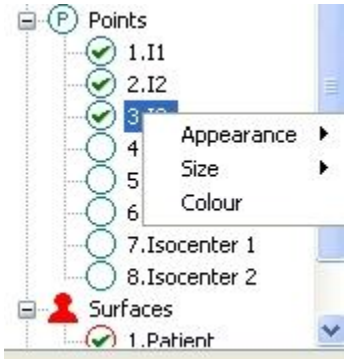
1. Load the patient into VERT, make the patient outline opaque (using right click on the Body outline in the structures section of the top right hand menu) and turn off other structures.

2. Turn on the marker points to be used as reference markers. Turn on the markers using the points option on the top right hand side of the screen

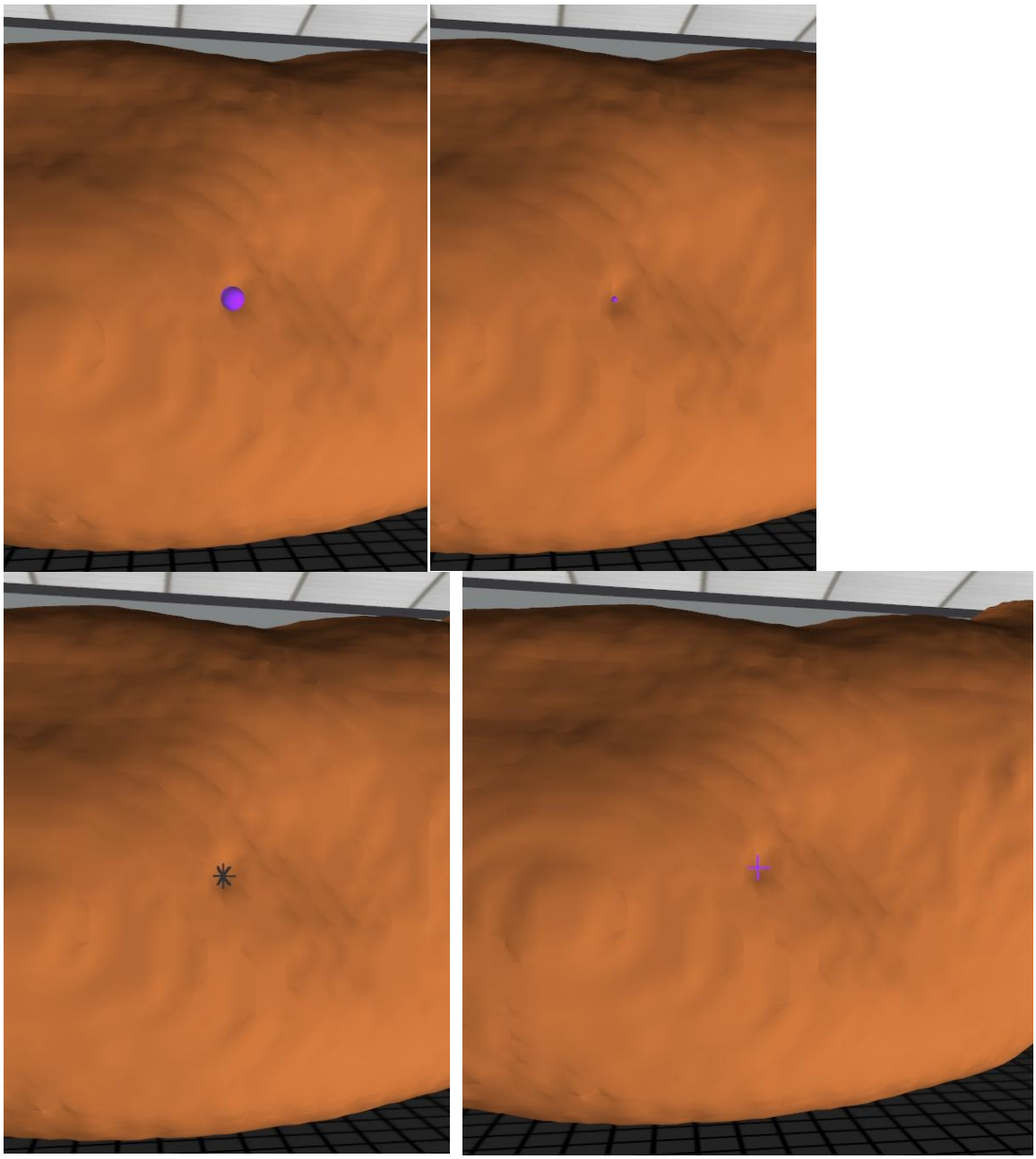
Here the markers are called I1, I2 and I3, if possible left lat, right lat and anterior would have been useful. To turn the markers on use the round green tick box to toggle them on.



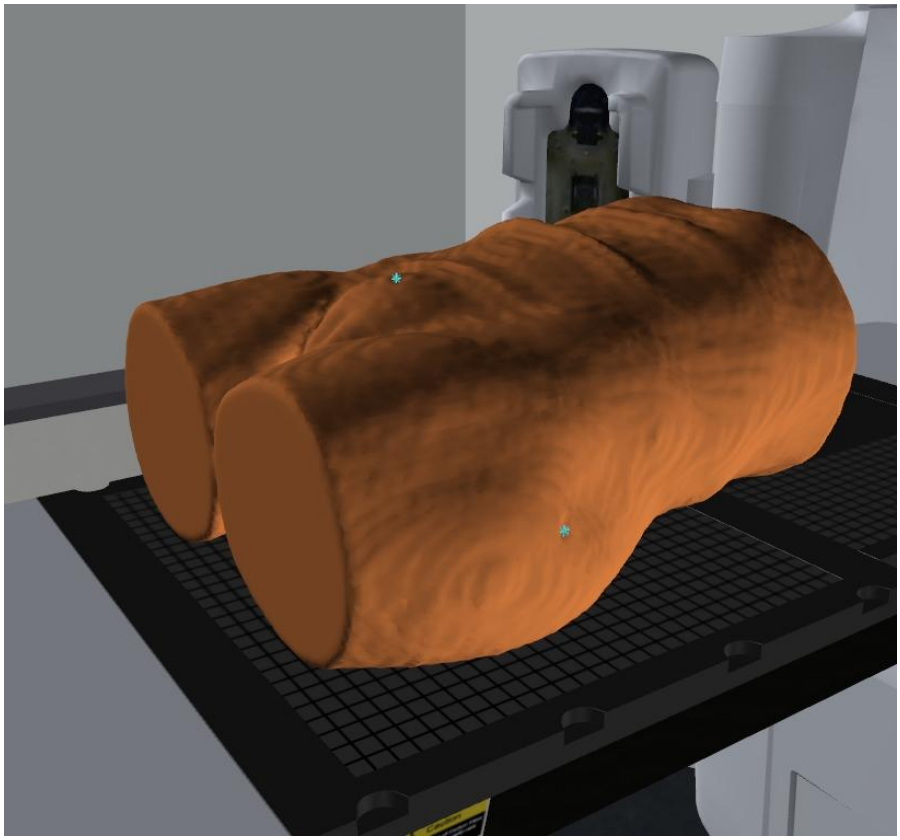
3. Set up the marker appearance to maximise the visibility of the markers on the patient's skin and according to preference. The appearance size and colour can be changed by right clicking on the marker name and choosing an option.



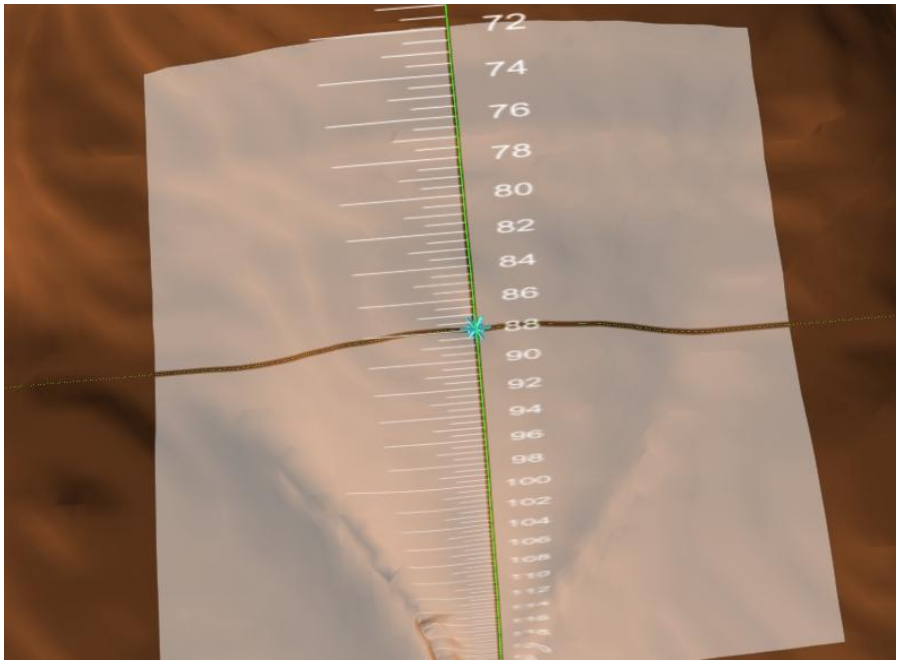
Different visualisation options



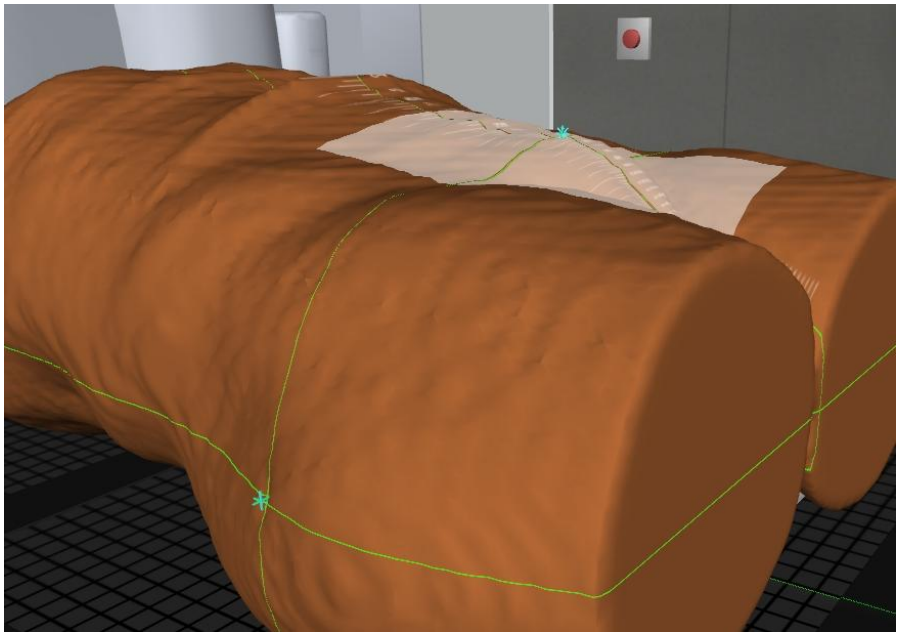
4. The markers will now be visible on the patients skin



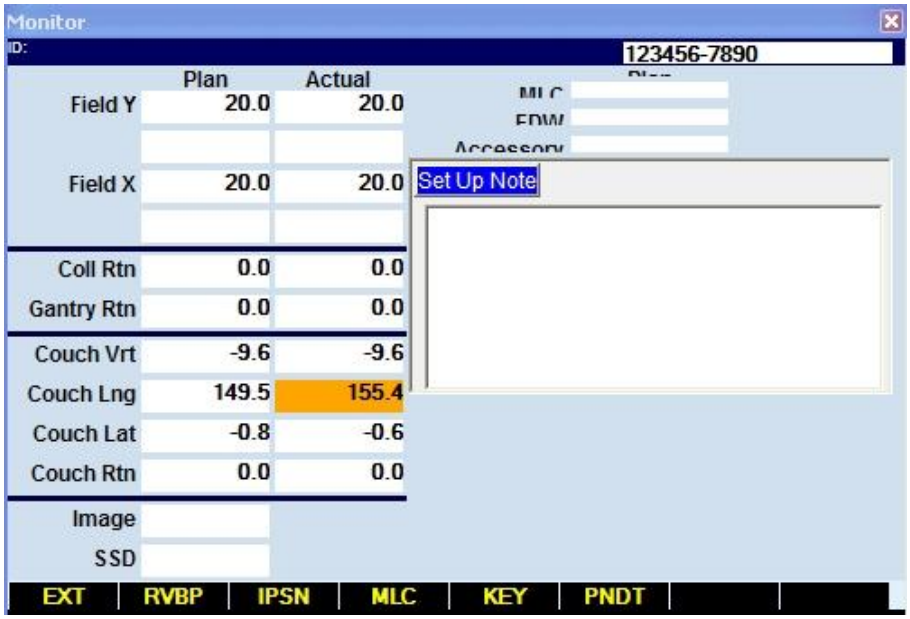
5. Set up to the markers using the lasers, the field light and the SSD



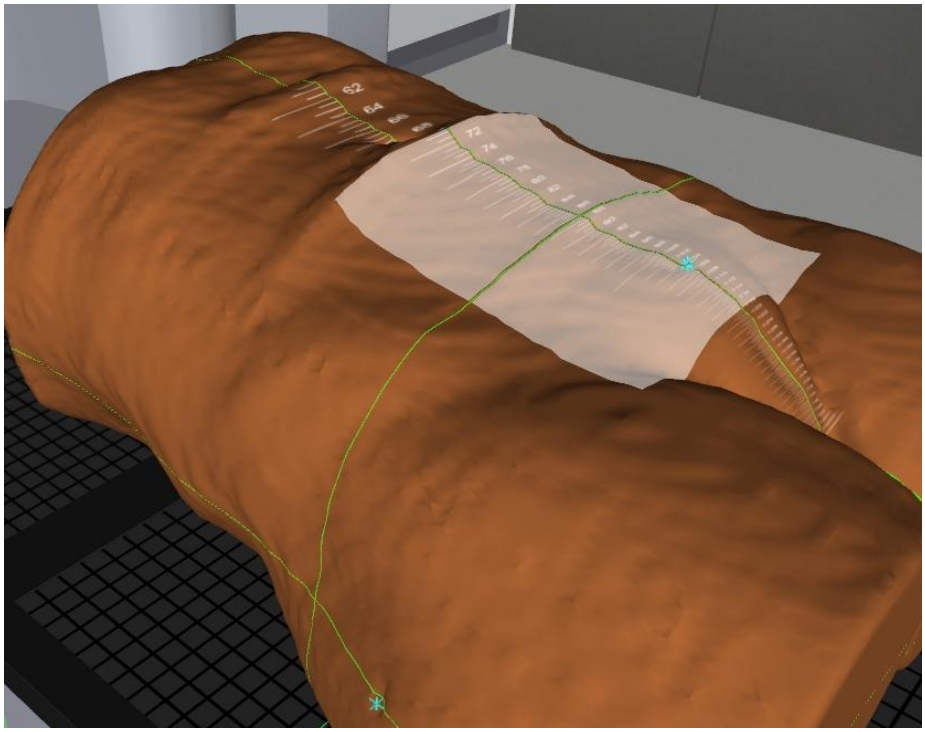
The lateral crosses line up with the lasers



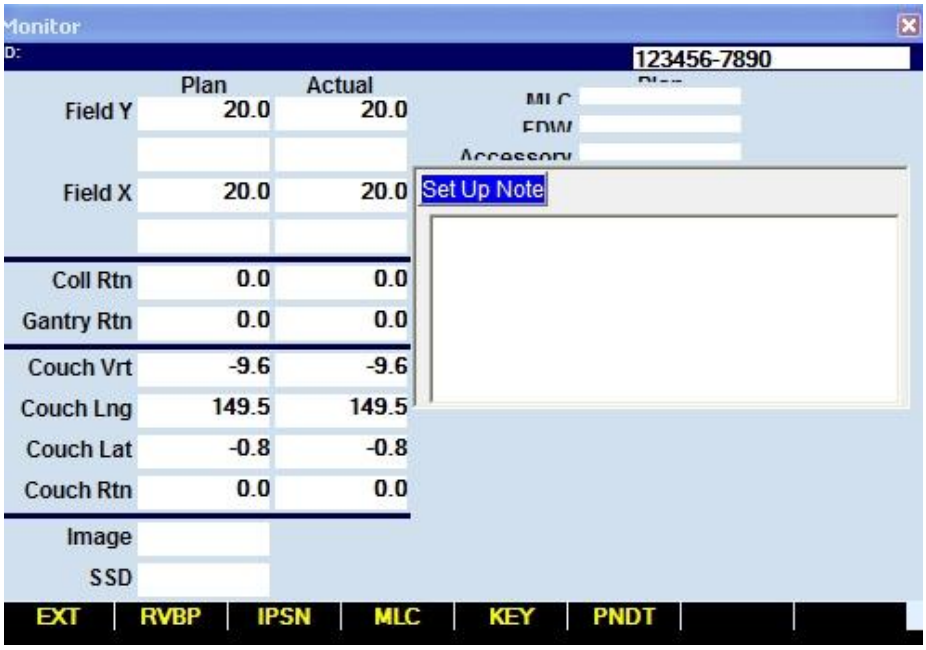
The display monitor will show that the couch is not at the planned position. The orange inhibit bar shows the incorrect longitudinal position of the couch in this case.



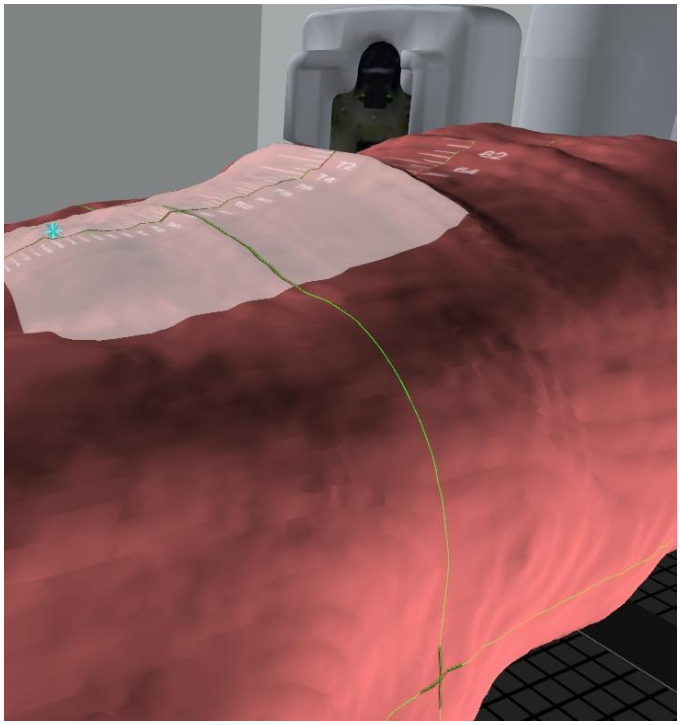
Using the shift measurement from the treatment plan move the couch to set up to the treatment isocentre



The in room monitor display should now show the patient is in the treatment position



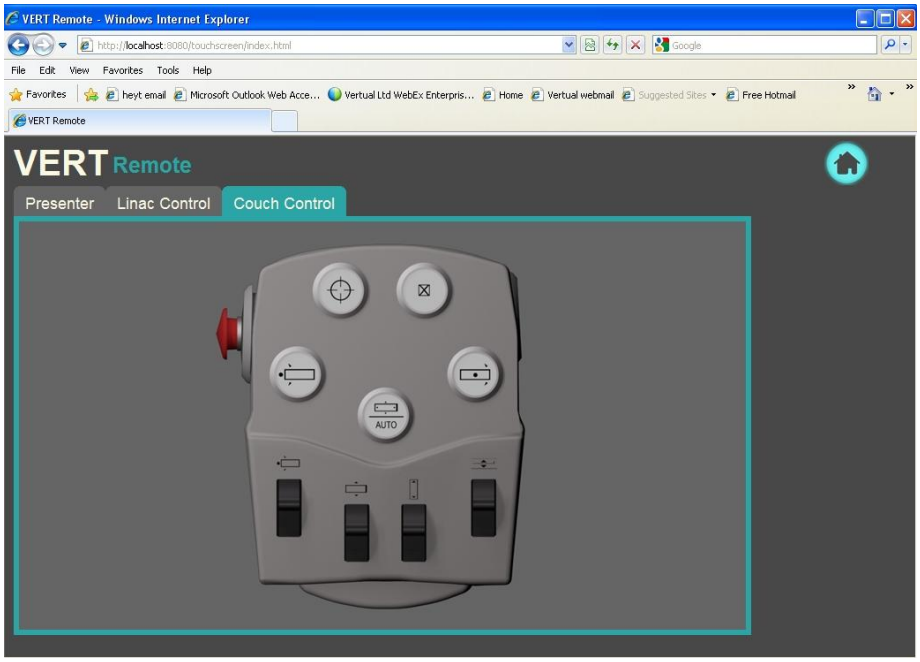
Turn on the skin marks using the view, apply skin marks option. The lasers should line up with the patient skin marks.

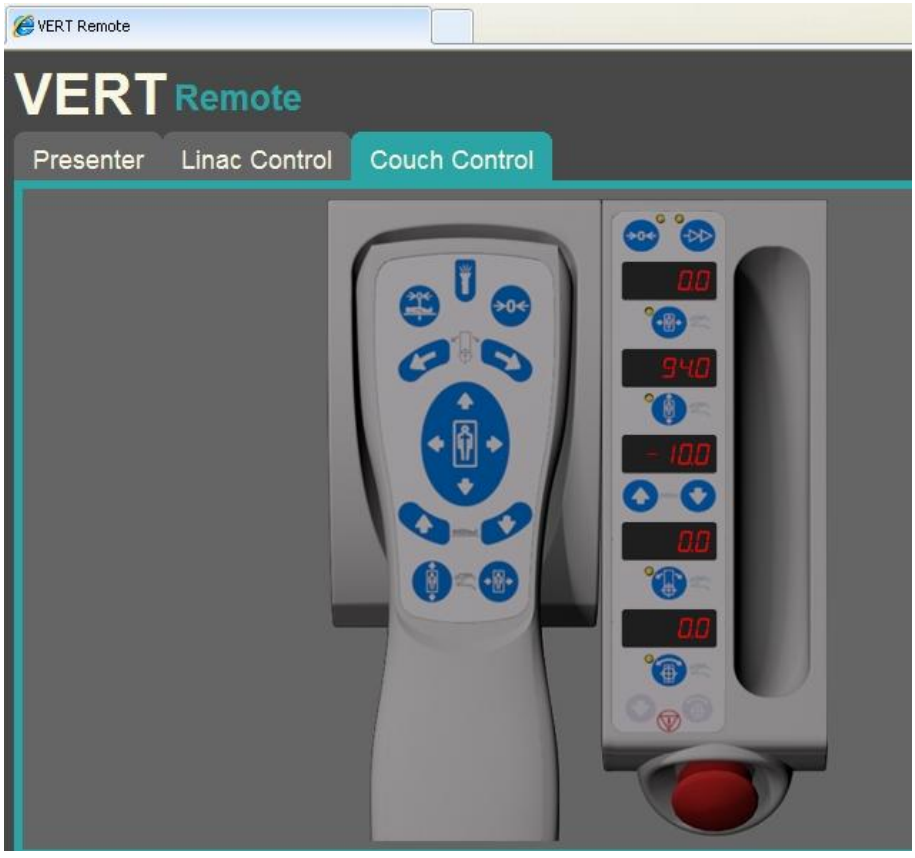


Couch controls

The couch can be moved using the hand pendant controls id applicable to the Linac, the simulated couch controls on the web browser touch screen display or by using the machine tab.

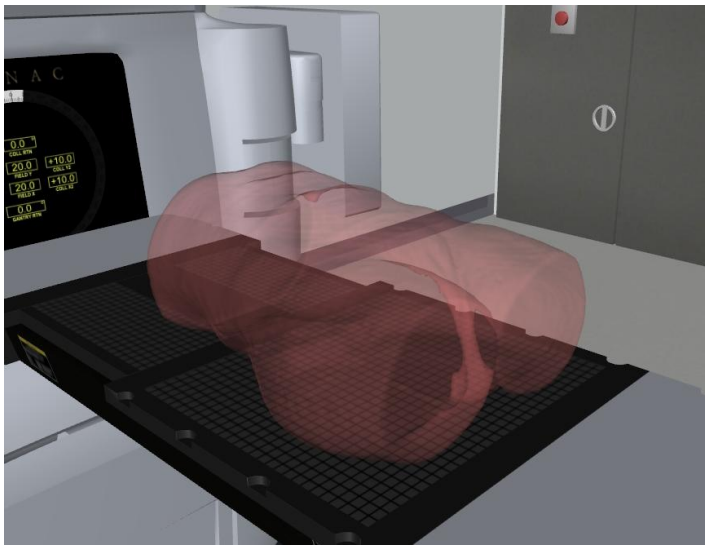
The couch controls are accessed from the home page in the touch screen option on the 3rd tab. Varian, Elekta and Siemens couch controls will appear depending on the Linac selected in the main VERT window.



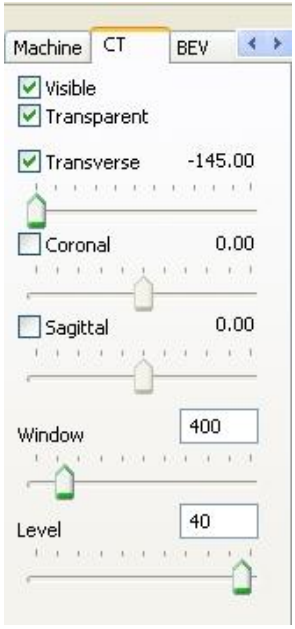


Method 2 (plan does not contain markers)

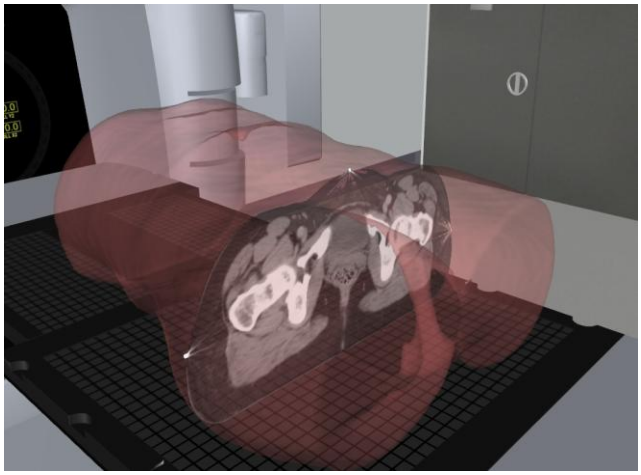
1. Load the patient into VERT, make the patient outline transparent and turn off other structures.



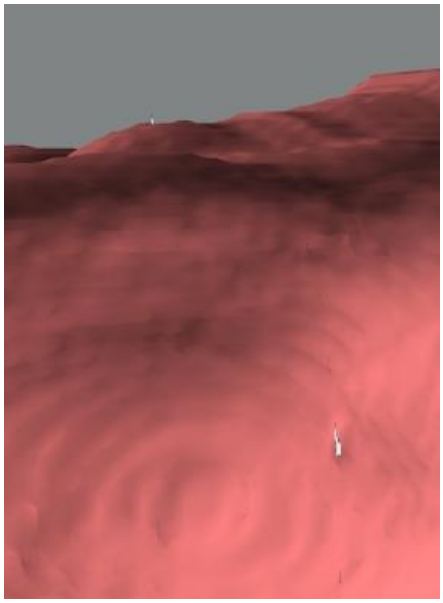
2. Choose the CT tab from the bottom right hand menu section and turn on the transverse CT



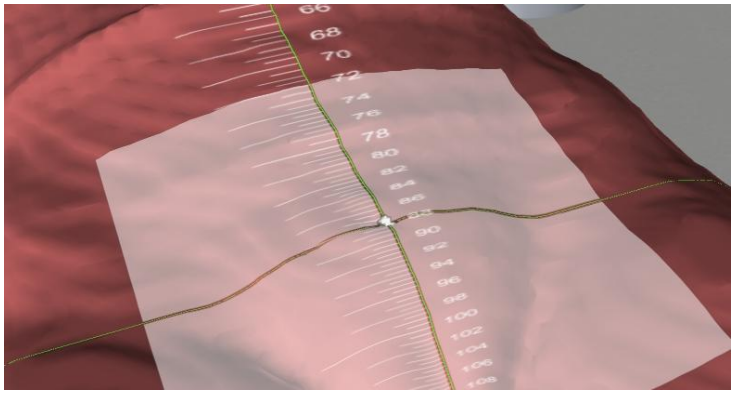
Scroll the CT using the slider until the white CT markers can be seen at the patient origin position.



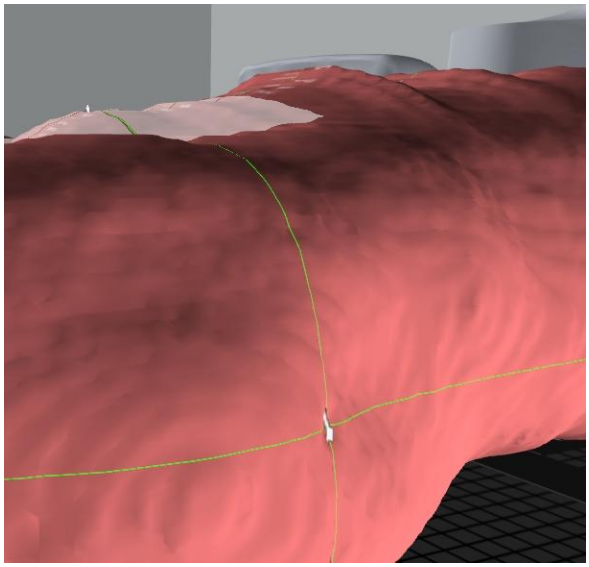
3. The patient outline can now be made opaque; the markers will protrude from the patient outline.



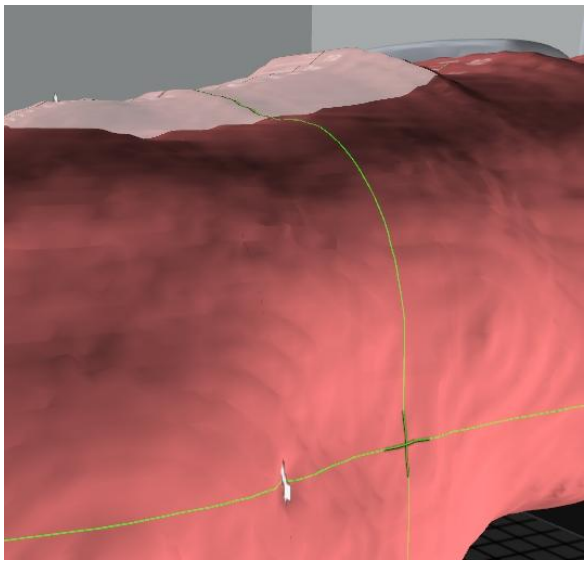
4. Set up the patient to the CT marker using the field light, lasers and SSD



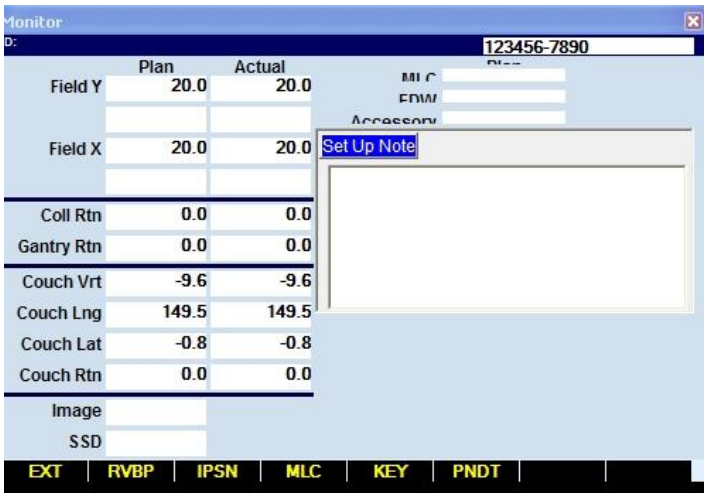
The lateral markers will also line up.



5. Make the isocentre shift as required. The in room monitor will again be showing the inhibit bar at this stage.



6. Turn on the skin marks. The lasers should line up with the skin marks if the isocentre move has been performed correctly.
7. The display monitor will now be free from inhibits.



Hint: It can be useful to have a dummy treatment sheet for demo plans stored by the VERT system. This can be an anonymised copy of the treatment sheet containing the prescription dose and shifts from the permanent marks. In some cases the outlining may have been performed in such a way that the CT markers will not protrude through the patient outline. In this case a new patient should be selected.

Chapter 12 IGRT workflow

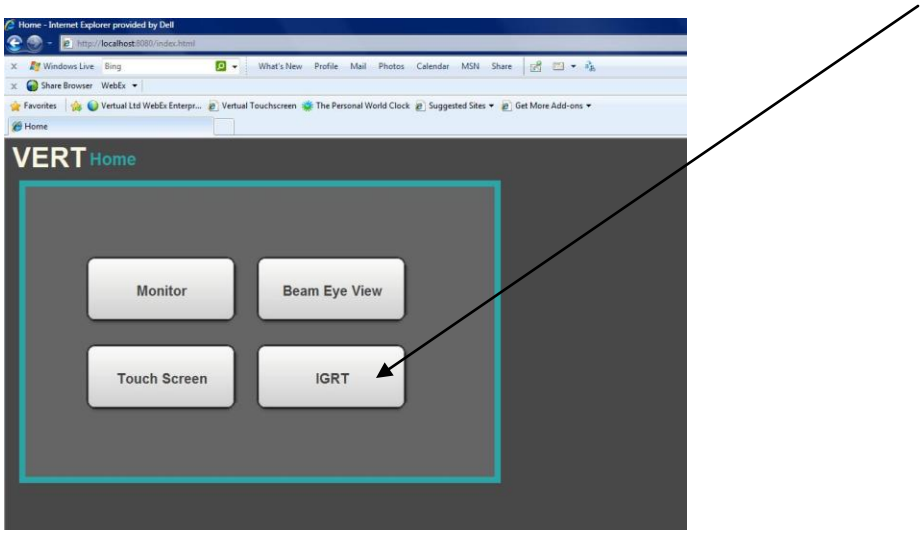
Patient required: any patient loaded onto VERT.

Time: 30 minutes.

This session will cover the following:

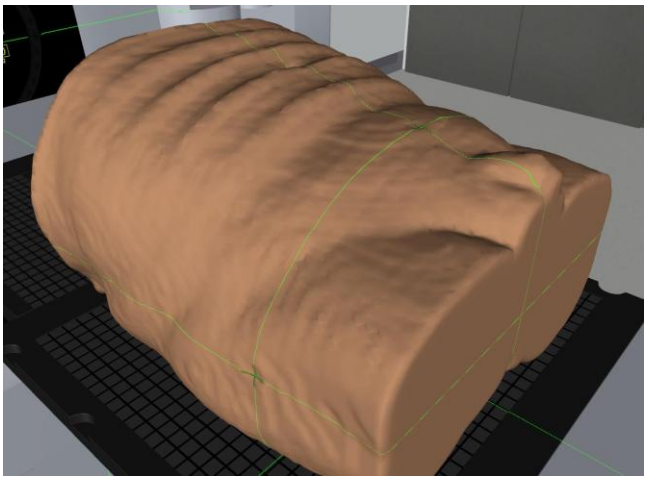
- Accessing the IGRT option
- Using random error option
- Matching images
- Interaction between IGRT interface and VERT set up error menu

To access the IGRT window select IGRT from the VERT touch-screen home page (if you don't have a VERT touch-screen you can also view the touch-screen page on your VERT PC screen. An internet connection is not required; this is a "local" internet connection.



IGRT Workflow

1. Within the main VERT window, a patient is loaded. Ideally have the patient outline visible and the skin marks switched on.
2. With the lasers on it is clear that they pass through the isocentre marks (skin marks) on the patients skin



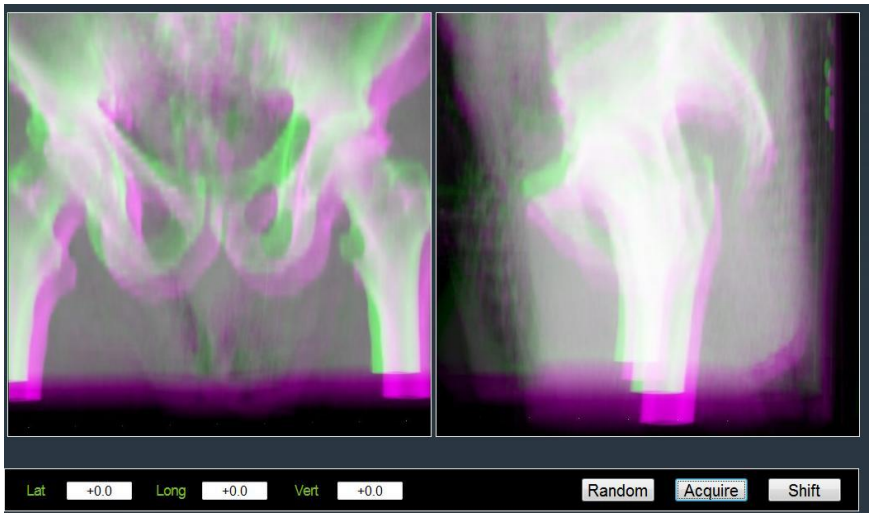
3. We now need to introduce a simulated error in position. We can do this by pressing the ‘Random’ button as shown below:

Press random to introduce a set up error

4. In the IGRT window (web browser), click ‘Acquire’. You will now see the planned and actual images overlaid.

Click acquire to generate a pair of images

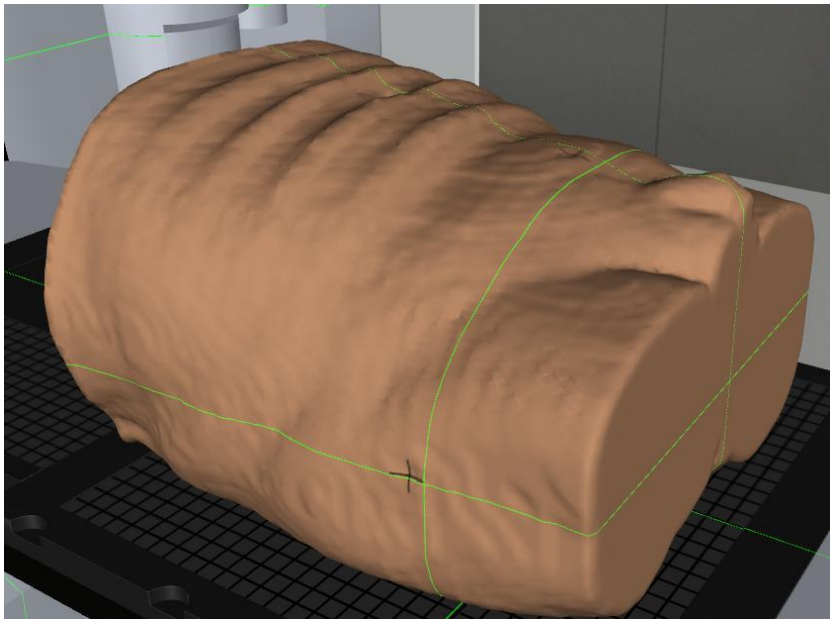
5. A pair of images are generated which will display the planned position and the new image at the new location with set –up error introduced. A purple and green wash will be displayed where the images are not aligned.



Planned image is purple and

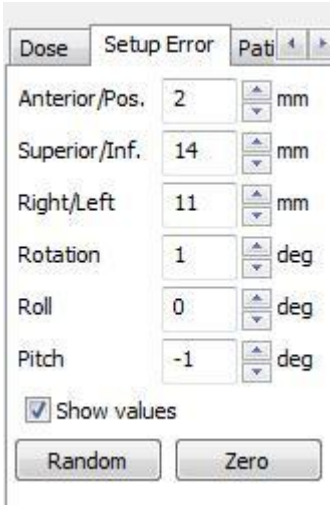
Actual image is green

In the main VERT window the patient will now appear with a random set up error and the lasers will not be on the skin marks



The setup error box will also register that a shift has taken place

Setup error tab, before random error has been generated



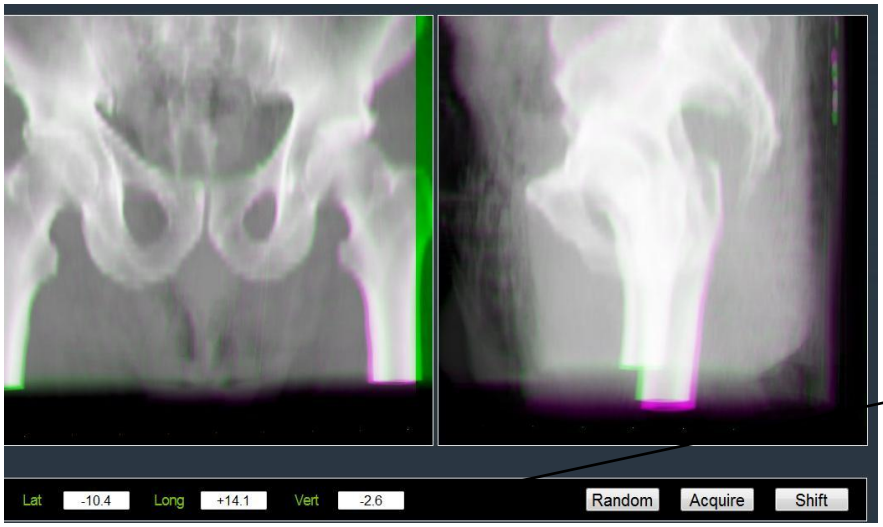
Setup error tab, after random error has been generated

Once the show values option is selected the magnitude of the shift is seen

Matching the Images:

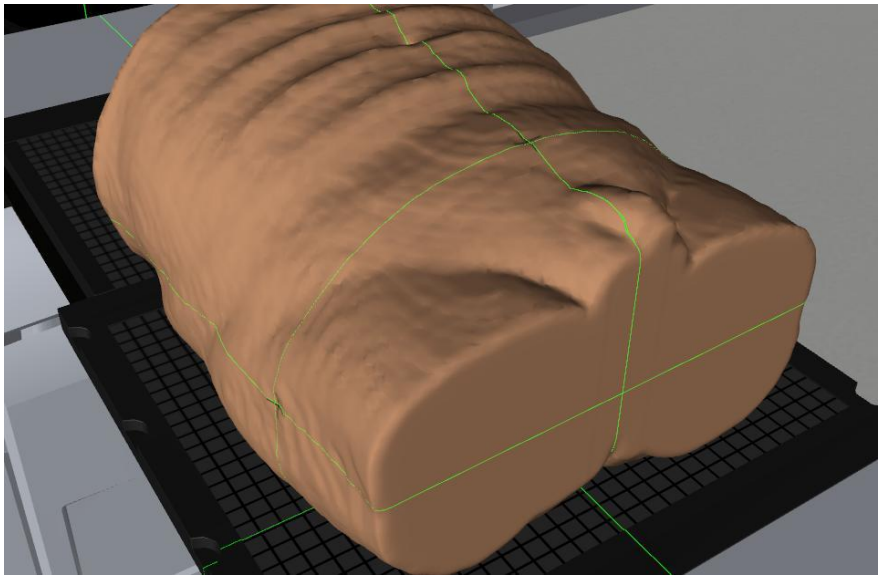
6. In the IGRT window, holding down the left mouse, move the image so the green and purple are overlaid and little colour or no green or purple is displayed. This indicates the images are aligned.

Once the images are aligned the Lat Long and Vert fields in the touchscreen interface will display the translation values to move the patient to the isocentre location

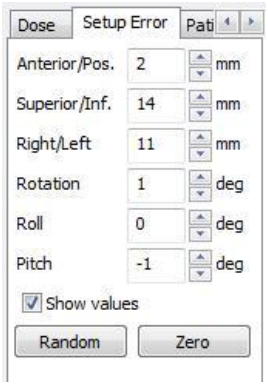


Magnitude of Lat Long and Vert shift is shown once the images are matched

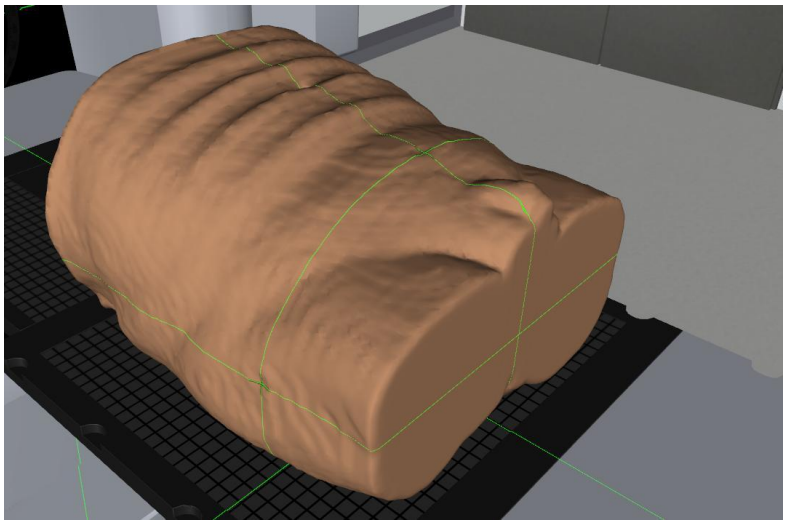
7. Pressing shift will move the patient back to the isocentre location using the moves calculated from the image matching process



The setup error menu will still display values at this point.



8. Select zero in the VERT setup error menu, this will reset the values in the setup error window and the separate fields will display 0



Chapter 13 Using keyboard shortcuts

Patient required: any patient loaded onto VERT.

Time: 10 minutes.

This session will cover the following:

- Keyboard shortcuts for use with VERT

Below is the list of key codes for the software:

K = Show Skin Marks

Left Arrow = Gantry-
Right Arrow = Gantry+
Up Arrow = Collim+
Down Arrow = Collim-
A = CT Slice -
Z = CT Slice +
E = Eye-flip (reverse left/right eyes in stereo)
Numpad-4 or C = Couch Ang-
Numpad-6 or V = Couch Ang+
Numpad-8 or S = Couch Lng+
Numpad-2 or X = Couch Lng-
B = Couch Lat-
N = Couch Lat+
Numpad+ (Add) = Couch Vrt+
Numpad- (Sub) = Couch Vrt-
L = Room Light

Use some of the shortcuts whilst running through a plan for one of the demonstration patients.

Section 2

Chapter 14 Example sessions to use with students

Vertual would like to thank the team from Birmingham City University and particularly Mark Holland for the preparation of the student session examples.

Linear accelerator – Machine geometry Session

Facilitator Notes

Introduction

- This session should be timed at around 1 hour.
- This session should be facilitated subsequent to the linear accelerator visualisation session.
- Check the students requirements as to whether or not they all are comfortable using the VERT system in stereoscopic 3D mode.

Revision

- Ask the students what the isocentre is.

  Definition of isocentre:

  "the isocentre is the point around which everything rotates. It is a fixed point inside the room, which is 100cm from the focal spot on the target."

Demonstration – facilitator led

- Import a 2-field parallel pair bronchus plan – ensure all structures and contours are invisible.
- Click on Beam 1 and reiterate the concept of beam divergence. Question the students as to how this phenomenon enables us to generate field sizes greater than 40cm x 40cm. Explain how this relates to similar triangles and introduce the concept of inverse square law.

- Visualise the axes in the "Scene → Machine" menu – demonstrate how the lasers coincide on the axes, introduce the X, Y, Z concept of three dimensional movements around the isocentre. Visualise how the ODR is at 100cm on the axes.

Student Exercises

- *If available, hand the students the pendant and virtual couch controls. Without using the ODR, get the students to position the top of the couch so it is 100cm away from the focal spot.*

- *Once they are happy they have achieved this, check if the distance is correct using the ODR.*

- *Separation exercise – explain the concept of patient separation and why this is important. Activate the external surface and ask the students to work together to identify what this patient's separation is.*

Demonstration – facilitator led: Single fields / Parallel pair techniques

- Visualise both beams on the parallel pair plan, implement the dose-wash so they can see how the lungs / spinal cord / skin surface (if visualised) receives a high dose.

- Activate the dose surface display and use the dose level slider to demonstrate that the highest dose falls at the entrance and exit points of the two beams. Introduce the concept of skin sparing and how opposed beams generate increased dose deposition via their entrance and exit contributions. Indicate that MV beams deposit skin dose due to their exit, rather than their entrance.

- Explain to the students that this technique would utilise a 6MV photon beam. Ask them why, considering the patient separation they have recently measured, you wouldn't use a higher energy.

- Introduce the concept of "phased" treatments, and how the geometry of the machine / treatment plan can be changed to minimise any further dose to some of the critical structures. Import a 3-field bronchus to illustrate this with dose wash.

- Check if there are any questions at this juncture.

Demonstration – facilitator led: Terminology

- Import the VHF, and introduce the concepts of Sup / Inf / Ant / Post etc.

- Import a pelvic plan and activate the skin marks.

- Demonstrate laser alignment to skin marks via a random setup error and how students will have to develop this terminology as second nature when they are in the department. Stress the importance of communicating clearly within the treatment room during setups, and the need for a "half and half" approach to movements during alignment.

Student Exercise

- *Get the students to all practice alignment and mastering fine movements on the handset / virtual couch controls (if available)*

Summarise session

- Ask the students to explain beam divergence and how we can utilise this in extended distance techniques.

- Reiterate the importance of how the lasers and ODR can help us to align and reproduce setups on a daily basis.

- Position and move the mouse pointer Sup, Inf etc from a skin mark on a visible patient and get the students to state in which direction you are moving.

- Ask any further questions that you deem are relevant.

- Finally, check if there are any questions from the students.

END OF SESSION

Chapter 15 Linear accelerator – initial visualisation session

Facilitator Notes

Introduction and initial scoping

- This session should be timed at around 1 hour
- Check the students requirements as to whether or not they all are comfortable utilising the VERT system in stereoscopic 3D mode
- Ascertain basic understanding of the linear accelerator – e.g.:
    - *Have you all visited a clinical department prior to starting this course?*
    - *When you visited the department, what machines did you see?*
- Brief background from facilitator on the linear accelerator and its application in radiation therapy:
    - *Historical – rise to dominance over the DXT / Cobalt machines that were the mainstay of radiation therapy in the mid-20th century*
    - *Three primary manufacturers worldwide*
    - *Multi-modality (question students – what do I mean by this?), choice of energy*
    - *Accuracy, range of movement*
    - *Ongoing development – MLC, EPID, dynamic radiation beam modulation and fluency of dose distribution*

Demonstration – facilitator led

Linear Accelerator Room

Commence with the Varian CX linear accelerator.

- Position the camera towards the rear of the maze. Slowly zoom into the room describing this as the viewpoint that patient's first experience. Explain to the students the importance of informing patients of the visual identity of the machine prior to their first treatment as it can be intimidating.

- Pan around the room slowly. Get the students to identify the two main components of the linear accelerator: the couch and the gantry.

- Get the students to identify the position of the emergency stops.

- Give students the mouse / X-box controller / iPad so they can move the camera around and view the Varian linear accelerator.

Now visualise the Elekta Synergy platform and Siemens Artiste linear accelerators.

- Explain some basic design differences like the Elekta gantry assembly being hidden behind the false wall, hence making the machine look a little smaller.

- Zoom in on the Elekta pendant on the virtual wall – if available; hold up the real pendant for comparison.

- Visualise the Varian iX and Elekta Synergy systems and deploy both the MV and kV imaging systems. Briefly explain the concepts of patient imaging and accuracy.

- Return to the Varian CX

- Explanation of Basic Linear Accelerator Components to the students

    - *Gantry – the gantry rotates 360° around the patient, and rotates around the isocentre.*

    - *Patient support – the couch. Can the students identify the weight limits on the VARIAN couch? Explain why this is necessary, introducing the concept of sag and replication of the same patient position on a daily basis.*

- Import in the VHF plan so that a field can be visualised

    - *Explain the concept of the primary and secondary collimation systems – these define the radiation field. Focus on the secondary collimation system. They are a combination of "straight" collimators creating a rectangular / square field notated by an X and Y value, and multi-leaf collimators which can shape to the target. Introduce the term "field size".*

    - *X and Y – the field size on most linear accelerators can be set between 4 x 4cm – 40 x 40cm. The field is the same as the radiation beam, and this is a divergent*

beam. This means that the radiation beam is bigger, the further away from the target. Demonstrate this by extending the visible beam to "full-length"

and projecting onto the treatment room wall with the gantry at 270 or 90 degrees.

- *ODR – the Optical Distance Reader. This may be referred to as the ODI (optical distance indicator), SSD (source to skin distance) or FSD (focus to skin distance) depending upon the department you are in. This indicator shines onto the patient's skin and demonstrates the distance from the patient's skin to the focal spot in the treatment machine.*

- *The isocentre – the isocentre is the point around which everything rotates. This is a fixed point inside the room, which is 100cm from the focal spot. Visualise the isocentre via the "Show axes" option in the "Scene → Machine menu", and also add the 100cm front pointer and the lasers. Rotate the gantry and move the couch to visualise how movements relate to it.*

- If available, all students should now take turns with the Varian, Elekta and Siemens handsets. By the end of the session all of them should be able to demonstrate an ability to toggle the room lights / field lights / ODR and lasers, and the capability to use all couch and gantry movements.

- If available visualise the virtual couch controls for each machine. Allow the students to explore and use these controls.

Summarise session

- Ask the students to name the three main manufacturers of linear accelerators.
- Get them to tell you the two modalities that linear accelerators operate on.
- Ask them what the isocentre is, and explain that this concept will be expanded upon in future sessions.
- What does collimation enable us to do?
- Ask any further questions that you deem are relevant.
- Finally, check if there are any questions from the students.

END OF SESSION

Chapter 16 Technique – Prostate

Facilitator Notes

Introduction and initial scoping

- This session should be timed at around 1 hour
- Check the students requirements as to whether or not they all are comfortable utilising the VERT system in stereoscopic 3D mode
- Confirm that all students have seen prostate patients treated
- Ask them to describe the beam arrangements that they have witnessed in the clinical department

Revision - anatomy

- Import a prostate plan and ensure that all surfaces and contours are invisible. Ensure that no beams are visible.
- In “Scene →Machine” remove the gantry and the couch.
- Activate the CT visualisation in all three planes – view may be changed to full screen if required.
- Get the students to identify key structures and relations to the prostate on the CTs to include:
    - Prostate
    - Seminal vesicles
    - Bladder
    - Rectum
    - Left and right femoral heads
    - Associated small bowel
- In particular with bladder and rectum, get the students to indicate what the tolerance doses are for these structures.

Discussion – pre-treatment

- Ask the students to explain what pre-treatment preparation the patient would need to do. This is in particular relation to the requirement for a full bladder and the reasons for this.

Demonstration – facilitator led

- Reactivate the gantry and couch

- Visualise the following internal structures:

    - Bladder
    - Rectum
    - Femoral Heads
    - GTV and/or CTV

- Use the CT sliders to move through the slices in all three planes, demonstrating how internal structures are outlined and rendered from the CT dataset on the planning system. Once this is completed deactivate the CTs.

Student Exercise

- *Ask the students what the position / support apparatus would be for this patient*

- *Add the external structure and activate the skin marks. Add a random setup error and get the students to align the patient with the lasers and field light.*

- *Once aligned, activate the axes and make the external structure semi-transparent. Zoom into the axes within the CTV to indicate how accurate alignment of the patient is critical in order to ensure that our isocentre is in the right position.*

Demonstration – facilitator led

- Ask the students to comment on what they think the beam arrangement for this case is.

- Click on each beam in turn to visualise. Discuss any MLC shaping, static / dynamic IMRT at this juncture.

- Ask the students to explain which of the beams would be wedged and why.

- Visualise all beams together and zoom into their intersection around the GTV / CTV. At this point activate the PTV surface.

- Display the dose colour wash on all surfaces except the external, and add the colour map. Change the units to whatever is most appropriate and familiar to the student group.

Student Exercise – plan critique

- *Ask the students to comment on the dose distribution, paying particular attention to the following:*

    - *Bladder*
    - *Rectum*
    - *Femoral heads*
    - *PTV*
    - *GTV / CTV*

- *Ask the students how the distribution might differ if alternative beam arrangements / techniques were used*

- *Display the external structure and change the transparency to fully opaque. Add dose colour wash and ask the students to explain why there is very little dose deposited on the skin in this technique.*

- *Get the students to give you a proposed prescription for this patient – activating the dose surface display will confirm what the delivered total dose was.*

Discussion – post-treatment

- Based on the dose distribution / prescription applicable to this patient, discuss possible side effects that may occur (both acute and chronic)

- Discuss how these side effects might be treated / alleviated to include patient instructions.

- Discuss how a change in technique may improve / worsen the side effects the patient may experience.

Summarise session

- Ask any additional questions that you deem are relevant.

- Review additional prostate plans if available (and there is time)

- Finally, check if there are any questions from the students.

Section 3 Example Session Planners

Example 1

Please complete the session description using the outline below.

- Title of session here

Facilitator Notes

Introduction

- Insert time for the session
- What other sessions or technique/anatomy sessions should this session be delivered close to?
- Check with the students whether 2D or 3D is preferred

Revision

Set the scene. Ask some brief revision questions of the students

Demonstration – facilitator led

- Plan import – relevant to session. Describe patient and what structures etc the patient should have.
- Steps needed to show the required elements

Student Exercises

- *Hands on description the students will partake in.*
- *Next steps once the initial hands on is complete.*
- *Further questions and answers*

Demonstration – further demonstration – next concept to be explained

- Activity 1
- Activity 2
- Activity 3
- Questions

Demonstration – facilitator led: Next concept

- Activity 1
- Activity 2
- Activity 3

Student Exercise

- *Describe hands on for the students*

Summarise session

- Activity 1
- Activity 2
- Activity 3
- Ask any further questions that you deem are relevant.
- Finally, check if there are any questions from the students.

Example 2

Lesson plan for using VERT

Subject:
Created by:

Tags/key words:	
Subject/description:	
Suggested year group and number of students:	
Previous student experience:	
Session aim:	The aim of this session is to: •
Session objectives/outcomes:	By the end of this session you should be able to: •

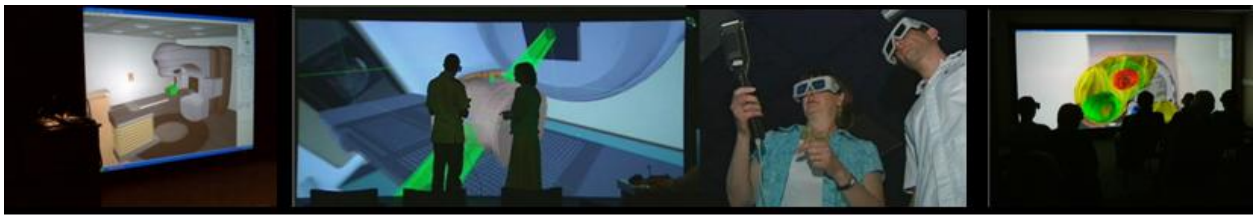
Approx. time	Content & teacher activity	Resources	Student activity

Suggestions:

Example 2, courtesy of Louise Coleman from University College Suffolk.

For further information about VERT and VERT training please contact the training department.

Email: training@vertual.co.uk or phone +44 1482 634739



© Vertual Ltd November 2011